# TENTH ANNUAL REPOR

OF THE

# FISHERY BOARD FOR

Being for the Year 18

IN TWO PARTS.

PART I.—GENERAL REPORT.
PART II.—REPORT ON SALMON F

## PART I.—GENERAL R

Presented to both Houses of Parliament i
Act 45 and 46 Vict. cap. 78.

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# TENTH ANNUAL REPORT

OF THE

# FISHERY BOARD FOR SCOTLAND,

**Being for the Year 1891.**

*IN TWO PARTS.*

PART I.—GENERAL REPORT.
PART II.—REPORT ON SALMON FISHERIES.

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## PART I.—GENERAL REPORT.

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Presented to both Houses of Parliament in pursuance of
Act 45 and 46 Vict. cap. 78.

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# TENTH ANNUAL REPORT.

TO THE MOST HONOURABLE

THE MARQUESS OF LOTHIAN, K.T.,

*Her Majesty's Secretary for Scotland.*

OFFICE OF THE FISHERY BOARD FOR SCOTLAND,
EDINBURGH, 3*d May* 1892.

MY LORD,

We have the honour to lay before you our Tenth Annual Report as regards the Fisheries under our superintendence for the year 1891, in terms of the Statute 45 and 46 Vict. cap. 78, consisting of two parts—Part I. General Report—Part II. Report on Salmon Fisheries. A third, or Supplementary Part, which will be exclusively occupied with scientific papers, is being prepared, but it has been found impossible to get it ready in time for presentation with this Report. It will be forwarded as soon as completed.

## PART I.—GENERAL REPORT.

As the second quinquennial period of the Board since its reconstitution in 1882 is coming to a close, the present is a favourable opportunity for taking a general survey of what has been done for the improvement and development of the Scottish fisheries during the ten years of its existence.

### 1. SCIENTIFIC INVESTIGATIONS.

The following is a statement of the sums which have been sanctioned during each of the following years and spent by the Board on Scientific Investigations :— Money spent on scientific investigations.

| Year. | Sanctioned. | Spent. |
|---|---|---|
| 1883–84 | £300 | £300 13 7 |
| 1884–85 | 1600 | 1430 0 11 |
| 1885–86 | 1500 | 1500 0 0 |
| 1886–87 | 2000 | 1647 5 3 |
| 1887–88 | 2000 | 1843 4 5 |
| 1888–89 | 2000 | 1804 4 3 |
| 1889–90 | 2000 | 2026 10 0½ |
| 1890–91 | 1800 (With £200 for travelling expenses.) | 1792 13 4 |
| 1891–92 | £1800 Do. | |

In addition a sum of £2500 was applied in 1886–87 for the purchase of the steamer 'Garland,' and £500 per annum allowed for its maintenance, which was increased first to £900, and afterwards to £1200 a year.

Absence of scientific knowledge regarding fisheries.

When the Board commenced its operations, it was a new departure in State administration. The Fisheries Commission of the United States was only established in 1871, and we were without the experience which has since been gained in America, Germany, Norway, and other countries bordering on the North Sea. The directions of the Act of Parliament creating the Board were very general. We were appointed to 'take cognisance of everything 'relating to the coast and deep sea fisheries of Scotland, and take 'such measures for their improvement as the funds under their 'administration not otherwise appropriated might admit of, but 'without interfering with any existing authority or private right.' Hitherto the fisheries had been practically left to take care of themselves. During the administration of the old Board, which had existed from 1809 under the name of the Commissioners of the British White Herring Fishery, scientific investigations had indeed been made from time to time into special points, such as the spawning of the herring, the capture of immature herrings by sprat fishermen, and the action of the beam trawl on herring spawning-beds. These inquiries were, however, limited both in character and extent, and were merely incidental to certain questions prominent for the time being. The absence of definite scientific knowledge relating to the fisheries had been felt and commented upon by Royal Commissions appointed to enquire into fishing questions; and when the new Board came into existence in 1882, it was found that, without further information as to the habits and life-history of the food fishes, it would be impossible to submit satisfactory reports to Parliament either as to the improvement or the regulation of the fisheries. It was accordingly resolved that scientific investigations should be instituted under a Committee, consisting of Professor Ewart (Convener), Sir James Maitland, Sheriff Forbes Irvine, and Mr Maxtone Graham. This Committee acted until 1886, when it was dissolved; and, in 1887, another Committee was formed, consisting of Professor Ewart (Convener), Sir James Maitland, Mr William Boyd, and Mr W. Anderson Smith, which continued till 1889. Since the dissolution of this Committee the scientific work has been under the immediate control of the Board, with Dr T. Wemyss Fulton as scientific secretary, but all the members feel, and desire specially to acknowledge, the valuable assistance which has been rendered by Sir James Maitland and Mr Anderson Smith.

Laboratories established.

Before describing the investigations undertaken, a word must be said as to the means which have been at the disposal of the Board. In 1884 a marine laboratory was established at St. Andrews, with the co-operation of Professor McIntosh, F.R.S., who was at the time engaged in making scientific investigations for the Royal Commission on Beam Trawling, under the late Lord Dalhousie; and this laboratory has continued in active operation ever since under Professor M'Intosh's charge. In 1885 another laboratory was

erected at Tarbert, Lochfyne, which was placed under the charge of Mr George Brook, F.L.S., and was occupied until 1887. During 1886–87 a portion of Rothesay Aquarium was made use of, and from 1884 until 1889 part of the scientific work was carried on at the Natural History Department of the University of Edinburgh, under the charge of Professor Ewart. Subsequently a marine laboratory was built at Dunbar, which has since been added to, and in connection with which the Board are now erecting a large hatchery for the propagation of sea-fish. In addition to the laboratories mentioned, the fishery cruisers have occasionally been engaged in aiding the scientific inquiries, as have also the staff of Fishery Officers around the coast. Since 1886 the small steam-vessel 'Garland,' although not at all sufficient for the work, has also rendered important services.

Haphazard character of former legislation.

At the time when the scientific investigations were begun very little was known regarding the habits of sea-fishes. Fishermen, who presumably ought to know something of the life-history of the fishes they catch, knew, as Professor Huxley has remarked, very little beyond the best way to catch them. Yet from the earliest period until comparatively lately, the practice has been to shape fishery legislation in accordance with local desires or the popular opinion prevailing at the time, and not upon ascertained conditions. A study of the statutes dealing with sea fisheries, especially those passed by Parliament from the middle of last century to about the middle of this, shows that vast sums of money have been expended uselessly, and injurious restrictions imposed for reasons which scientific investigations have now proved were illusory. About thirty years ago, however, an important change in this system was effected. Van Beneden on the continent, and Professor Huxley, Mr Spencer Walpole, Mr Shaw Lefevre, and others in this country made a stand against haphazard regulations, and in Great Britain their action found practical expression in the liberating Act of 1868 (31 and 32 Vict. c. 45), which repealed or amended 64 fishery statutes, and restored liberty of fishing. The Royal Commissioners who brought about this reform (the late Sir James Caird, Professor Huxley, and Mr Shaw Lefevre) refer in their report to the absence of knowledge about the habits of sea fishes, their reproduction, spawning places, and conditions of existence which is essential to effective regulation of the fisheries.

Opinions expressed at Fishery Exhibition, 1883.

An indication of the lack of accurate knowledge on these subjects as lately as 1883 was afforded at the London International Fishery Exhibition in 1883, when a high authority thus described the condition of things at that time:—'It is a very striking fact 'that the one point on which all speakers at the conferences held 'during the past summer at the Exhibition were agreed was this, 'that our knowledge of the habits, time and place of spawning, food, 'peculiarities of the young, migrations, &c., of the fish which form 'the basis of British fisheries, is lamentably deficient, and that 'without further knowledge any legislation or attempts to improve 'our fisheries by better modes of fishing, or by protection or culture, 'must be dangerous, and indeed unreasonable.'

Successful results obtained.

It is a source of satisfaction to the Board that their labours in

this field of fishery work, even for the comparatively short time over which they have extended, have yielded successful results, and have contributed materially to the advancement of that knowledge of fishery problems, the want of which was felt and deplored by the Royal Commissioners of 1866. The scientific work carried on by the Board, the chief results of which have been described from year to year in their Annual Report to Parliament, may be summarised briefly as follows:—

Direction of inquiries instituted.

1. Inquiries into the influence of beam-trawling on the fish supply, especially within the territorial waters; the capture and destruction of immature fish by various modes of fishing; the condition of the inshore fisheries for shell-fish and the supplies of mussels and other bait for line fishermen; surveys and examination of the fishing grounds, &c.

2. Investigations into the food, fecundity, reproduction, habits and migrations of the food fishes, the location of their spawning grounds and of the nurseries of young fish, the time and duration of spawning, &c.

3. The study of pelagic and demersal ova, and of the development of the food fishes and edible molluscs from the egg onwards.

4. Inquiries into the micro-organisms in river waters, and associated with salmon disease, and into the food of fishes in inland waters.

5. Observations on the temperature, salinity, and physical conditions of the sea around the coast.

6. The artificial propagation of sea fish and shell fish to restock depleted grounds.

Effect of beam trawling.

The investigations into the influence of beam trawling, which have been carried on with great regularity and care, have furnished a mass of scientific and statistical evidence unexampled in the history of any fishery, and have been followed by the prohibition of this mode of fishing within the territorial seas. As stated in former Reports, various portions of the inshore grounds were for experimental purposes closed against beam-trawling, and by the Herring Fishery (Scotland) Act of 1889, the territorial waters were included in the prohibition, certain powers being reserved to the Fishery Board. Closely related to beam-trawling is the capture and destruction of immature fish, which is generally regarded as the most important of the fishery problems awaiting solution in the immediate future. In certain foreign States and English fishery districts the landing or sale of immature fish under certain sizes has already been made penal; and in 1890 an International Fishery Conference was specially convened in London to consider this subject so far as it affected the diminution of the fish supply from the North Sea. Extensive observations have been made by the Board as to the distribution of immature fish on the East Coast of Scotland at various distances from shore and in water of different depths; the minimum size at maturity of the different species and the proportions captured by various modes of fishing, with especial reference to the mesh of trawl nets, have been ascertained, as has also the action of the beam trawl in destroying immature fish according to the time the net is down and the nature of the

bottom. The results were embodied in a Report which was prepared by Dr Fulton, under directions of the Board, and was described (we believe with perfect accuracy) by the Vice President at the Conference 'as one of the most important, if not the most 'important document that had up to the present, been contributed 'to the Fishery Literature of this country.'

Food and propagation of edible fishes investigated.

The inquiries into the food and propagation of the edible fishes have been also prosecuted on an extensive scale. The food-material of nearly 20,000 specimens caught at various parts of the coast and at all seasons of the year has been examined, and this research has yielded valuable results both in regard to the protection and regulation of the fisheries and the increase of the fish supply by artificial means. The fecundity of nearly all the food-fishes has been determined, the nature of pelagic and demersal ova has been carefully studied, and the distribution of the former in the waters over the breeding grounds and along the coasts investigated. The development from the egg onwards, and the characteristics of the young of the majority of the edible fishes have been described—including the herring, haddock, whiting, cod, ling, turbot, plaice, lemon sole, flounder, &c., and also of the most valuable forms of bait, the mussel and the clam. The spawning of the herring and of the other food-fishes has received special attention. Since 1888 upwards of 30,000 white fish—such as cod, turbot, plaice, &c.—have been individually examined. By this means the time and duration of the breeding season has been determined, and the important fact has been proved that on the East Coast of Scotland, where the investigation was mainly carried on, the spawning grounds of the valuable food-fishes (cod, haddock, plaice, turbot, &c.) generally lie outside the territorial limit,—contrary to the belief formerly held,—and that only forms of comparatively little value, such as the flounder, dabs, and gurnards, &c., spawn within the three-mile limit. The importance of these facts cannot be over-estimated. They bear directly both on the question of establishing a close-time and the measures proper to be taken for the regulation of fishing on the breeding grounds. The trawlers, driven outside the inshore waters, generally take to the breeding grounds, for there the hauls are most abundant. The significance of this fact, in connection with the falling off in the inshore fisheries, is becoming too grave to be longer overlooked. The growth of population has been followed by an increase in the demand for fresh fish, the extension of the means of distribution has ministered to this demand, and if the floor of the ocean is to be swept without public regulation, the ordinary fishing grounds will prove inadequate to maintain the supply. The destruction of spawning fish is proving a serious evil. In Germany, where this matter has been carefully examined, it is now held to be more important to protect the spawning banks, than to prevent the destruction of immature fish. Some of our fisheries are, in fact, in danger of being exhausted unless judicious regulations are rigidly enforced.

Protection of spawning banks.

Migratory movements of fishes.

During the last three years experiments have been carried on to determine the migratory movements of fish, and nearly 3000 have

been labelled and returned to the sea. A percentage of these has been recovered, and steps are now being taken to apply the same method on a large scale to the herring. The experiments are not sufficiently advanced to justify any final conclusion as regards all fish, but undoubtedly as regards many of them the facts already ascertained prove that until they reach a certain size they do not leave the territorial waters.

Decay of fisheries for shell-fish.

The means of increasing the diminishing fisheries for shell-fish have received careful attention. Surveys have been made of the more important mussel-beds on the East Coast, the extensive clam-bed in the Firth of Forth, the cockle-beds at Barra, and a detailed examination of the great mussel-growing area in the Clyde is at present in progress. The French system of growing mussels on wattled bouchots has been tested side by side with the bed-system, and a series of experiments have been made on board the 'Garland' to test the comparative efficiency of different natural baits, and of various artificial substitutes. A physical and biological investigation has also been made of a number of sea-lochs on the west coast, in order to ascertain their suitability for the growth and culture of oysters (the Scottish oyster fisheries having sunk to a very low point), and a special lobster pond has been constructed at Brodick, Arran, in which about 200,000 young lobsters were hatched last year.

Physical observations.

The physical observations into the temperature and salinity of the sea have been carried on on board the 'Garland' and the fishery cruisers, and at ten fixed Stations daily—five on the east coast and five on the west. By the courtesy of the Northern Lighthouse Board, observations are allowed to be taken daily at the Bell Rock and Oxcar Lighthouses, the Lightship at the North Carr and also at the mouth of the Tay. Many thousands of observations are thus made every year, and several valuable reports have already been published.

From this brief summary of part of the work done, it will be seen that considerable progress has been made since 1883 in extending the knowledge of the habits and life-history of the food-fishes; and it is gratifying to learn that the results obtained by the Board have been gratefully acknowledged by high authorities and found useful in other countries.

International arrangements for regulating fishing in North Sea.

In recent years the attention of the authorities of various maritime States, especially those around the North Sea, but also in the Mediterranean and in America, has been forcibly called to the diminution of the fish-supply within the territorial seas and on much-frequented fishing banks off-shore. The falling off in the supply of valuable flat fishes, such as turbot, sole, and plaice, from the North Sea, has led to various conferences of those engaged in the fishing industry. At the International Fishery Conference held in London in 1890, at which representatives were present from Germany, Denmark, Holland, France, Belgium and Spain, it was resolved that scientific investigations should be carried on by each country, particularly into the capture and destruction of immature fish by the beam-trawl, prior to the assembling of an official International Conference to deal with the subject by inter-

national agreement; and at a conference of representatives of the fishing industry held in London last February resolutions were passed, that in view of the diminution of the valuable food-fishes, the hatching of sea fish should be undertaken on a large scale, and measures adopted to prohibit the sale of immature flat fishes under a certain size. The decrease in the fish-supply from the off-shore banks has not yet become so marked off the Scottish coast as is the case further south; but from the statistics given below as to the yearly increasing number of Scottish beam-trawlers; the flocking northwards of English vessels from their own depleted grounds; and the actual diminution in the quantity of flat fish landed there is reason to apprehend that in the course of very few years a similar result will be brought about here. As has been stated above, the Board are at present having erected at Dunbar, by means of the ordinary vote for scientific investigation, on a site granted by the War Office and the Council of the Burgh a large hatchery for sea fish, with the necessary tanks and pumping apparatus, which, when complete, will permit of several hundreds of millions of the food fishes being hatched every season and planted on the fishing grounds. It will therefore be possible for the first time in this country to adopt active measures to directly add to the fish supply, as has already been done in the United States, Norway, Canada and Newfoundland.

Erection of a sea-fish hatchery.

## 2. TELEGRAPHIC EXTENSION.

Appropriation of surplus brand fees.

In the Board's report of 1882, it was urged that remote fishery districts should be brought into telegraphic connection with the rest of Scotland, as had been recommended by the Select Committee of the House of Commons on the Herring Brand in 1881. The Lords of the Treasury having been pleased to authorise the sum of £1000 out of the surplus brand fees to be applied to this object, an arrangement was made with the Post Office authorities, under which they agreed to extend the Post Office telegraph to certain stations, on condition that if the revenue did not amount to the sum named, the deficit should be made up either by the Board or by local guarantors. In 1882–3 the whole of the surplus brand fees had been added to the £3000 annually voted by Parliament for harbours, and the following is a statement of the amount received from brand fees and its appropriation to harbours and telegraphic extension during the following years:—

| | | Appropriation. | |
|---|---|---|---|
| Year. | Amount. | Tel. Extension. | Harbours. |
| 1882–3 | £3000 | — | £3000 |
| 1883–4 | 2300 | £1000 | 1300 |
| 1884–5 | 2400 | 1000 | 800 |
| | | in addition to £600 spent in scientific investigations. | |
| 1885–6 | 5200 | 1000 | 4200 |
| 1886–7 | 5200 | 1000 | 4200 |
| 1887–8 | 2100 | 1500 | 600 |
| 1888–9 | 1650 | 1500 | 150 |
| 1889–90 | — | — | — |
| 1890–91 | 3324 | 1500 | 1824 |

In addition there was spent out of a special vote for the Castle Bay telegraph, £131, 12s. in 1885–6; £122, 5s. 8d. in 1886–7; and £92, 16s. 6d. in 1887–8. The £1824 entered under the head of harbours to the credit of the year 1891, represents a reserve fund for the Eyemouth harbour guarantee.

Telegraphic extension agreements expired.

The agreement which was made with the Post Office was entered into for seven years, and in three cases it has now run out. These are the following:—

| Stations. | Annual Amount Guaranteed by Board. £ | s. | d. | Years in which payments have been made. | Total sum paid by Board. £ | s. | d. |
|---|---|---|---|---|---|---|---|
| St Margaret's Hope, &c., Orkney | 187 | 6 | 8 | 1885–91 (both inclusive) | 999 | 3 | 8 |
| Castle Bay, Barra . | 702 | 13 | 4 | " | 3273 | 1 | 2 |
| Walls and Reawick, Shetland . . | 170 | 0 | 0 | " | 1160 | 15 | 0 |

The question of the renewal of the agreement in these cases is at present under the consideration of the Post Office authorities and the Treasury. The following is a list of the other cases in which a guarantee has been granted by the Fishery Board, either solely or jointly with others:—

Agreements current. Amount of guarantee.

1. Guaranteed solely by the Fishery Board for Scotland.

| | Amount Guaranteed. | Reduced after 8th Aug. 1891. |
|---|---|---|
| Achiltibuie, Ross . . | £123 | £78 |
| Arisaig, Inverness . . | 251 | 128 |
| Barvas, Lews . . . | 28 | 26 |
| Coll and Tiree . . . | 531 | 344 |
| Durness, Sutherland . . | 255 | 140 |
| Garrabost, Lews . . | 18 | 16 |
| Portnaguran and Gress, Lews . . . | 156 | 92 |

2. Borne by the Board jointly with other guarantors.

| | | |
|---|---|---|
| Brae, Ollaberry and North Roe, Shetland . . | £133 | £112 |
| Hillswick, Shetland . . | 141 | 84 |
| Lochbuie, Mull . . | 66 | 43 |
| Lochranza, Arran . . | 106 | 71 |
| Port of Ness, Lews . . | 236 | 135 |

In the case of Lochbuie the Board's obligation is joint and several. In the case of the others the Board's liability is limited to a certain amount, and the co-guarantors also to a certain amount.

From an account printed under Appendix E. it will be seen that the total sums paid by the Board on account of telegraphic extension in each of the following years are as follows:—

| | | | |
|---|---|---|---|
| 1885, | £701 | 13 | 7 |
| 1886, | 703 | 4 | 8 |
| 1887, | 724 | 12 | 3 |
| 1888, | 824 | 16 | 11 |
| 1889, | 2,252 | 11 | 9 |
| 1890, | 2,282 | 11 | 6 |
| 1891, | 2,303 | 16 | 4 |
| Total | £9,793 | 7 | 0 |

Great benefit of telegraphic extension as an aid to improvement in fisheries.

These extensions have proved of immense benefit to the Scottish fisheries, serving as they have done to bring the fishermen and buyers into closer touch with one another, and to make fishermen acquainted, at very short notice, as to the places off which shoals of herring have appeared, so that they might proceed there without loss of time, and participate in the fishing. When there has been a heavy and unexpected catch of herrings the curers are, by means of the wire, able to order and receive a supply of salt and barrels with little delay, charter additional vessels, and get their goods insured. Early information is also obtainable by consigners residing in these remote districts as to the state of the different foreign markets,—the current prices and the stock of herrings on hand, so that they are in a position to send their consignments to those ports at which they can most advantageously dispose of them. Further, those persons engaged in the fresh fish trade are enabled, at the shortest notice, to know at what populous centres suitable supplies are being delivered, and are consequently able to regulate the trade in such a way as to secure greater benefit to themselves and to the public.

Extensions to Loch Ranza.

For instance, the extension to Loch Ranza in Arran, which is now self-supporting, has been greatly taken advantage of by buyers, agents, and fishermen,—cargoes of herrings from the loch being generally advised in Glasgow four hours previous to their arrival, and large quantities of the herrings changing hands during the passage of the vessels.

Reports of Fishery Officers.

The Board continue to receive reports from their district fishery officers of the great advantages of the telegraph in their respective districts, extracts from which may be here given.

Wick District.

The Wick officer reports that the extension of the telegraph to the more remote portions of his district continues to be taken advantage of to an increased extent not only by the fishing population, who use it largely for trade purposes, but by the inhabitants generally. As stated last year, hired hands intending to go to east coast fishing stations during the summer herring fishing use it largely in making their engagements. In many cases fishermen consign their own fish to southern markets in Scotland and England, their consignments being invariably advised, and their

sales intimated to them, by telegraph. The few curers at the outlying creeks of Portskerra, Skerray, and Tongue also do all their business with the southern markets by the same means. The state of the fishing, when successful, at Scrabster, Lybster, and other places, is immediately wired to the head-quarters of fish-curers at Wick, or to their residences, the calls for empty barrels and salt attended to without delay, and additional coopers and women gutters despatched. When stormy weather prevents boats from arriving at the ports at which they are for the time located, the wives and relatives of the fishermen wire to other fishing ports for information, and very often, in the course of an hour or two, they have intimation of the safety of their friends. As in former seasons, when the fishing was attended with success, the resident officer wired the officers or correspondents at adjoining stations intimating the fact, the fishermen there thus being enabled to participate in a prosperous fishing.

Orkney District.

The Orkney officer reports that on Saturday morning, the 22nd of August last, a large shoal of herrings was discovered about three to seven miles off the Island of Stronsay by a few boats which happened to be at sea. Having ascertained the position of this shoal the officer wired the particulars, for the fishermen's information, to all the stations in Orkney. On the Monday following, every boat employed in the herring fishery in Orkney was on the fishing ground indicated, with the result that the heaviest fishing ever obtained in one day in Orkney (for the number of boats employed) was landed on Tuesday the 25th, the average catch for the whole fleet being 50 crans. The number of boats fishing was 108, and their total catch was 5400 crans, valued at £3240, a large proportion of which would have been lost, but for the telegraph. Wick fishermen having also been apprized of the circumstance, a number of the Caithness boats had good takes on the same ground, and landed them at Wick. Consequent upon such a heavy and unexpected fishing, additional coopers, gutters, packers, barrels, and salt had to be immediately sent for from Wick so that the herrings might be cured while they were in a fresh state, and this was acomplished by means of the telegraph.

Shetland District.

The officer of Shetland district reports that the telegraphic extensions there are being largely used for fishery purposes, more especially at the remote parts of the district, fishery business of every description being conducted by means of the telegraph. It would be almost impossible to carry on the herring fishery at these remote stations without its aid; especially since the use of steam vessels has become so general that all shipments of herrings have to be insured and consigned by wire, steamers generally reaching their destination before the letters concerning them could arrive by post. The fresh fish trade is also carried on by means of the wire, curers being advised almost daily of the state of the markets, and thus being enabled to send their fish to the most profitable centres.

Stornoway District.

Regarding the localities which have been aided by the Board in Stornoway district, the officer there reports that the telegraphic extensions, accomplished by means of the funds provided by the Board, continue to give the greatest satisfaction to the fishermen

and others resident in the Lewis. It is now fully eight years since the first of these extensions was carried out in the district, and from time to time since then other much-needed improvements of a like nature have been accomplished through the Board's instrumentality. After the lapse of so many years, it is not too much to say that they have proved a source of much benefit, and have materially aided the fishing communities in getting better value for their commercial produce than previously, as well as in contributing largely to their domestic comfort and general welfare.

Fort-William District.

From Fort-William district the officer reports that the extension to Arisaig was beneficial to the fishermen in that locality, as it enabled them to receive timely notice of the best herring fishing grounds, while the telegraph office at Dervaig has been used to some extent by those engaged in the lobster fishing, which is almost the only fishing carried on there. The extensions to Coll and Tiree have also been of great utility to the fishermen. At Coll, considerable advantage was taken of the telegraph by those engaged in sending away fresh fish, as also in procuring a supply of empty barrels and boxes, whenever necessary, for their proper conveyance to market. One drawback is that the steamer does not call at Bouse, where the East Coast crews fish. Last year they cured 60 tons of cod and ling there, and no doubt, if there had been proper communication, a larger quantity of fresh fish would have been despatched to market. As at Coll, the extension to Tiree was of great service in encouraging the consignment of fresh fish,—an industry which has steadily increased, year by year, since the opening of the telegraph office there. Besides improving the lobster fishing it has been of considerable service in enabling the fishermen to dispose of their cured fish to the best advantage.

## 3. HARBOURS.

Sums spent on harbours, and contributed by localities.

The total sums spent under this head by the Board and contributed by the localities between 1882 and 1st April 1892 are as follows:—

| Harbour. | Paid by the Board. | | | Contributed by Locality. |
|---|---|---|---|---|
| Rosehearty, | £732 | 9 | 11 | £500 |
| Findochty, | 8,331 | 8 | 9 | 3,000 |
| Crovie, | 925 | 0 | 6 | 300 |
| St Monance, | 1,339 | 18 | 1 | 500 |
| Portnacon, | 900 | 0 | 0 | 300 |
| Ness, | 8,863 | 3 | 8 | 3,000 |
| Port Knockie, | 6,957 | 0 | 0 | 3,500 |
| Broadford, | 7,875 | 0 | 0 | 2,625 |
| Coldingham, | 3,000 | 0 | 0 | 10,000 |
| Auchmithie, | 4,125 | 0 | 0 | 1,375 |
| Balintore, | 5,700 | 0 | 0 | 1,900 |
| | £48,749 | 0 | 11 | 27,000 |

Large sums formerly voted by Parliament for fisheries.

Of these works, Rosehearty in Aberdeenshire and Findochty in Banffshire, were in course of execution by the old Board in 1882 at the date of its dissolution. The others have been undertaken since that date, and the only two still unfinished—Ness and Balintore—are well forward towards completion. These new harbours have all been of the greatest benefit to the fishermen, and our only regret is that the small sum at our disposal prevented us from dealing more liberally with the applications for assistance which have been received.

In former reports we have expressed our views on this subject with sufficient distinctness. The system of distributing premiums or bounties amongst fishermen engaging in the herring fishery is of old date, and since 1809, in some cases the sums so voted and applied amounted to over £20,000 a year, the total paid for 16 years (1809–1824) during which the system was in operation under the Fishery Board, being £114,514, 7s. 3d. From 1809 to 1829 large bounties were also granted on barrels of cured herrings which received the official brand—amounting for some years to as much as £70,000 in the course of a single year, the total for the 16 years being £660,587, 9s. 6d. Thus during the 21 years which elapsed after the establishment of the Fishery Board in 1809, the Government of the day advanced from the Imperial Exchequer, for the promotion and encouragement of the herring fishery in Scotland, the sum of £775,101, or an average of nearly £37,000 a year.* Unquestionably it was a sudden fall to reduce the public assistance to an annual grant of £3000 per annum. When the bounties ceased, this sum was directed to be applied —£2500 to Harbours, and £500 in providing materials for the repair of the boats of poor fishermen, and since 1850 the whole of the £3000 has been applied to harbours exclusively, conform to a Treasury Minute to that effect. Since 1881, the sum granted has been supplemented out of brand fees. The brand was the Board's certificate that, in their officers' opinion, the barrels of fish to which it was attached came up to the standard entitling the curer to the bounty; and it had come in course of years to have such mercantile value, that when in 1830 the bounty was abolished, the brand was still in demand. But in 1858 the Government, on the recommendation of a Royal Commission, fixed for the first time a charge of 4d. a barrel, which has always been a cause of discontent in the trade. The total sum received from this source has amounted since 1858 to £211,249.

Board's proposals for systematic harbour extension.

In some years, however, the amount available for harbours from surplus brand fees has been very small, and in 1889–90 it amounted to nothing at all. We again take leave to say that the only proper way of dealing with this subject is to abandon the present hand-to-mouth system, and fix definitely upon a plan of harbour extension all round the coast, to be carried out systematically over a series of years. We have not the smallest doubt that if we had been able even to promise assistance to some deserving cases, it would have been a great stimulus to local effort.

* A Table printed in the Appendices to our Ninth Report, p. 31, gives the full details.

We are aware that it has been seriously questioned whether the relief of local taxation from imperial sources is beneficial to a locality,* or just to the general taxpayers of the kingdom. But we contend that the building of harbours is an incident of the national ownership of the fisheries, essentially necessary to the realisation of the enormous wealth which is to be drawn from the sea, a field fitted and prepared for the cultivation of food as much as the land, but which can only be adequately dealt with by assistance from imperial sources.

For details as to the position of the Harbour Works under construction in 1891, we refer to the Engineers' Reports printed under Appendix E.

Fishermen's titles.

In this connection we may again advert to a fact upon which we enlarged in our Report for the year 1884, that the most grievous sufferers from our present system of land tenure are the fishermen around the coast. A fisherman does not require a title for his house different in form from the title which he has to his boat. A sufficient title would place at his disposal a fund of credit which would be available when his nets were swept away, or he desired to assist in building a harbour to help him to prosecute his calling, whereas in many cases he is a mere squatter, without any title at all to the house he occupies beyond the receipt which he holds for the price which he has paid for it.

## 4. FISHERMEN'S LOANS.

Crofters' legislation.

In 1886 the Lords of the Treasury, in the exercise of the powers conferred by the 32nd section of the Crofters Holdings (Scotland) Act and the relative Public Works Loans Act, made an advance of £20,000 to the Board to be expended in making loans to fishermen for the building, purchase, and repair of vessels, boats, and gear, with a view to the encouragement and promotion of the fishing industry among the crofters resident in certain parishes in the counties of Argyll, Inverness, Ross and Cromarty, Sutherland and Caithness, and Orkney and Shetland. The above grant of £20,000 was increased to £30,000 in 1887 and 1888. In 1889 the sum granted was reduced to £25,000, and further reduced in 1890 to £10,000.

Rules as to loans.

By your Lordship's directions the Board prepared a series of rules under which the rate of interest to be charged for loans was 2½ per cent., subsequently increased by the Treasury to 3½. By these rules it was provided that in no case should the advance exceed three-fourths of the value of the mortgaged boat, if a new one, or two-thirds, if an old one. So stood the arrangement when the subject was discussed in the House of Commons on the 29th of August 1887, when, in obedience to a promise then made by the Government, the rules were further amended so as to sanction an

* This subject is fully discussed in the 24th Report of the General Board of Lunacy, pages 45–56, and the 29th Report, pages 43–45, where it is conclusively shown that the lunacy grant has led to an increase in the number of persons registered as lunatics.

advance to the whole value of a new boat, minus one-tenth. The rules as finally issued bear date 22nd February 1888, and the first loan was made on the 26th of March following. Down to the 31st of December 1889 the total sum advanced amounted to £20,926, 6s. 7d. By the 31st of December 1890 it had reached £29,443, 16s. 7d., but at the end of the year it was decided that no further loans should be made in the meantime. The last loan was made on the 23rd of January 1891, and at the 31st of December of that year the total sum advanced amounted to £30,111, 16s. 7d. Of this sum instalments (including interest) amounting to £15,483, 18s. 4d. have fallen due, of which there has been repaid £10,282, 8s. 10d., and £5155, 19s. 8d. is in arrear.

Sums lent.

Number and amount of loans completed; total instalments, including interest, paid; and number and amount in arrear.

Appendix F., No. I., is a return showing the number of loans carried out in each crofting fishery district, the amount paid over, and the total instalments paid, including interest, from the date on which the Crofters Holdings (Scotland) Act, 1886, was given effect to, till 31st December 1891, together with the number and amount of instalments in arrear.

Proceedings taken against defaulters.

The Board greatly regret that there is such a large amount of arrears to be reported. Every endeavour has been made, both by taking legal proceedings and otherwise, to reduce them, but with very poor results, even in cases where the Board had reason to believe that the borrowers were in a position to pay the instalments of the loans as they fell due. In many cases the Board have had to pay heavy legal and other expenses, not only in carrying out prosecutions but in taking possession of the borrowers' boats (some of which were abandoned and left uncared for) in order to avoid almost a total loss. In one or two instances these expenses have exceeded the net proceeds of sale carried to the borrowers' account; and in almost every instance, after they have been credited with the net proceeds, a considerable balance remains to be met, which the Board deem irrecoverable, regarding which see Appendix F., No. II.

Arrears of loans deemed irrecoverable.

This Appendix is a return of arrears of loans granted on security of boats mortgaged to the Board, deemed to constitute bad debts, as at 31st Dec. last, to write off the principal of which against the Local Loans Fund the authority of Parliament is required by section 15 (2.) of the National Debt and Local Loans Act, 1887 (50 Vict. cap. 16). It shows the fishery districts in which the loans referred to therein were made; the number of borrowers in each case; the dates when the loans were granted, the amounts of these loans; the amounts repaid by the borrowers; the expenses incurred in prosecution of delinquents, taking possession of and selling boats, the dates when the boats were abandoned, surrendered, taken possession of, or wrecked; the dates when the boats were sold; the amounts realized by sales or recovered from the Insurance Company; the net proceeds of sale credited to borrowers' accounts; the outstanding balances, exclusive of interest, considered irrecoverable; and the ground on which the arrears of loans are deemed to constitute bad debts.

Particulars thereof.

From this return it will be seen that at 31st Dec. 1891 there were 39 cases of arrears of loans which were in such a position that the Board considered the balances due as irrecoverable. In 37 of these cases the boats which were mortgaged to the Board in security for the loans were taken possession of and sold. Of these boats, 16 were voluntarily surrendered by their owners because they found themselves quite unable to fulfil their obligations to the Board, 15 were taken possession of by the Board's fishery officers after the defaulters had been threatened with proceedings for recovery of arrears, and 6 were abandoned by their crews and left uncared for, as it frequently happened that the crews quarrelled among themselves, and left the boats generally in a very neglected condition, and thus made it increasingly difficult to realise anything like a fair price for them.

## 5. STATISTICS.

When the Board took office the only available statistics related to cured fish—herring, cod, and ling—the number and value of the boats engaged in the fisheries, and the number of men and boys employed. It was obvious that statistics so imperfect could not accurately represent from year to year the true condition of the fishing industry, and the Board lost no time in organising the collection of statistical information, through its fishery officers, in regard to the quantity of fish landed, and their approximate value, shell-fish included. The system as organized by this Board was subsequently adopted by the Board of Trade for the rest of the United Kingdom, and fishery statistics relating to the whole of the United Kingdom are now published monthly, which has been followed by the collection of similar statistics in various Continental States. This has entirely superseded the old method of obtaining such information—which was to appoint a Royal Commission to travel round the coasts and collect testimony, the testimony so collected being generally tendered by interested parties, coloured by prejudice excited by some popular agitation active at the time, and largely composed of evidence objectionable on the score of hearsay, uninformed and misleading. Now, however, we know with an approximation to accuracy how the facts actually stand, and some of the more important inferences which may be drawn from these statistics may be here briefly indicated.

**Collection of fishery statistics originated by Board.**

1. The first is the growing difficulty which this country feels, and we fear will continue to feel, in maintaining its hold on the Continental markets, and the importance of discovering new markets and probably new modes of manufacture. Hitherto the herring fishery has been the fisherman's great stand-by. It is that which puts most money in his pocket, and chiefly maintains his family. But it absolutely depends on the Continental market. Within the past ten years Sweden and Norway have been making great strides in the cure of herring. Sweden seems to experience a periodical

**Continental trade. Increased foreign competition.**

ebb and flow in the great herring fisheries of Böhuslan. Years of abundance are followed by periods of no herring at all. One of the abundant periods has recently returned, and Sweden is now placing large numbers of cured herring on the German market. Norwegian herrings also are now being sent in large quantities to this country preserved fresh in ice, at prices which enable the fishermen at various parts of the coast to buy these herring for the purpose of bait. Both in Norway and Sweden great efforts have been made in recent years to select, cure, and pack herrings according to the Scottish system. The Scotch curers formerly, after long persistent effort, guided and assisted by the Fishery Board of the day, were able to break down the practical monopoly of the Dutch, and to obtain a preponderating position in the great markets of the Continent. In imitation of this success, Sweden and Norway have taken steps to obtain an accurate knowledge of the Scottish system by sending Commissions over to study the methods of cure, and by inducing Scottish gutters and curers to proceed to these countries to teach the natives; and the publications of the Fishery Board on the cure of herrings, such as the new branding regulations, and the reports of the Brand deputations have been published *in extenso* in Sweden, Norway, and Holland. Again, the German Government are building a harbour at Heligoland, to be a sort of depot for their fishermen in the North Sea, and from which fast steamers will run with cargoes of fish to Bremen, Hamburg, and other ports. There is thus much reason to apprehend that the Continental herring trade will not be in the future a source of greater wealth or as much wealth to the Scottish fisherman as in the past.

Germany operating from Heligoland.

Increased beam trawling and decreased line fishing.

2. Comparing fishing for white fish as carried on by line fishermen and beam trawlers, it is significant to observe that while from 1809 to 1884 or 1885 the returns show a continuous rise in the number of fishermen and fishing boats, since then there has been a continuous decline, which is chiefly accounted for by the fact that since the disastrous years in the herring trade of 1884 and 1885, East Coast fishermen have been compelled to do away to a great extent with crofter and halfdale fishermen, the boats being now better and more effectively manned. Steam line boats—a new kind of boat implying the possession of considerable capital, and which made their first appearance in 1887—are increasing. Last year there were 19 such vessels sailing from Aberdeen, all manned by local fishermen except two. But the ordinary line fishing boats are going down in number, and the number of men to whom they give employment is also going down, while the trawling fleet is constantly receiving additions. This important fact is proved by the following statistics, which have been prepared from returns in the possession of the Board, and which are very instructive:—

1. *Fishermen.*—The number of fishermen and boys continuously employed in sea-fishing increased from 1882 to 1885, since which year the number has steadily decreased. The statistics are as follows:—

| | Fishermen and Boys. | Total Number employed in Sea-Fishing Industry.* |
|---|---|---|
| 1882 . . . | 48,296 | 99,396 |
| 1883 . . . | 49,722 | 101,011 |
| 1884 . . . | 49,860 | 102,563 |
| 1885 . . . | 51,097 | 101,037 |
| 1886 . . . | 48,919 | 96,895 |
| 1887 . . . | 49,221 | 100,194 |
| 1888 . . . | 48,618 | 97,881 |
| 1889 . . . | 47,943 | 99,856 |
| 1890 . . . | 47,150 | 96,534 |
| 1891 . . . | 45,524 | 97,034 |

The number of fishermen and boys engaged in sea-fishing last year is the smallest recorded since 1875, there being 1626 less than in 1890, and 5573 less than in 1885.

2. *Boats.*—The same observations are true in regard to fishing-boats. They increased from 14,973 in 1882 to 15,427 in 1885, since which time they have decreased year by year. The number employed last year was the smallest recorded since 1868, viz., 13,801, being 433 less than in 1890, and 1626 less than in 1885. The figures are as follows:—

*Number of Fishing Boats.*

| | 1st Class. 30 ft. keel and upwards. | 2nd Class. 18 ft. to 30 ft. keel. | 3rd Class. Under 18 ft. keel. | Total. |
|---|---|---|---|---|
| 1882 . . | 5101 | 4423 | 5449 | 14,973 |
| 1883 . . | 5226 | 4400 | 5621 | 15,251 |
| 1884 . . | 5382 | 4278 | 5724 | 15,384 |
| 1885 . . | 5309 | 4311 | 5807 | 15,427 |
| 1886 . . | 5175 | 4318 | 5742 | 15,235 |
| 1887 . . | 4979 | 4296 | 5757 | 15,032 |
| 1888 . . | 4777 | 4217 | 5803 | 14,797 |
| 1889 . . | 4604 | 4239 | 5761 | 14,604 |
| 1890 . . | 4407 | 4238 | 5589 | 14,234 |
| 1891 . . | 4313 | 4146 | 5342 | 13,801 |

Beam-trawlers have, on the other hand, increased in numbers. Last year there were 132 as compared with 43 in 1883.

* This includes curers, coopers, and 'other persons.'

Beam Trawlers.

| | No. | Tonnage. |
|---|---|---|
| 1883 | 43 | 2004 |
| 1884 | 61 | 2284 |
| 1885 | 105 | 2875 |
| 1886 | 109 | 2914 |
| 1887 | 103 | 2304 |
| 1888 | 107 | 2689 |
| 1889 | 110 | 3608 |
| 1890 | 118 | 5967 |
| 1891 | 132 | 6484 |

3. *Value of Boats and Gear.*—The value of the boats corresponds to the variations in the numbers recorded above. The maximum of £923,956 was attained in 1885, since which year the value has gradually fallen. Last year the boats were valued at £676,452, or £247,504 less than in 1885. The value of nets shows the same rise to 1885, and fall thereafter. Last year the nets were valued at £611,150, or no less than £173,576 beneath their value in 1885. The value of lines has, on the other hand, increased almost year by year up to 1891, when they were valued at £127,928, or £13,650 more than their value in 1882, and £8164 more than their value in 1885.

Decreasing supply of flat fish.

But although beam-trawlers have increased so greatly in numbers and tonnage, the increase in the total quantity of flat fish caught is not commensurate with the increase in the means of capture, as the following figures show:—

| Year. | Turbot. | | Lemon Sole. | | Flounder, Plaice, and Brill. | |
|---|---|---|---|---|---|---|
| | Cwts. | £ | Cwts. | £ | Cwts. | £ |
| 1883 | 3,902 | 11,080 | 1,702 | 3,225 | 67,226 | 48,409 |
| 1884 | 4,234 | 9,368 | 4,163 | 5,589 | 72,758 | 47,729 |
| 1885 | 7,350 | 13,535 | 5,898 | 7,486 | 83,180 | 52,865 |
| 1886 | 3,882 | 9,774 | 7,573 | 9,372 | 81,164 | 50,198 |
| 1887 | 5,282 | 14,426 | 11,737 | 13,836 | 96,354 | 59,863 |
| 1888 | 5,424 | 16,310 | 12,669 | 16,512 | 87,184 | 55,918 |
| 1889 | 6,338 | 20,472 | 14,391 | 21,295 | 74,270 | 53,072 |
| 1890 | 5,554 | 18,459 | 16,651 | 27,386 | 81,309 | 68,187 |
| 1891 | 5,015 | 17,215 | 17,739 | 30,223 | 78,776 | 67,103 |

It is evident that while the prohibition of beam trawling within the territorial waters may have been a right step, with a view to the recuperation of inshore grounds, it will be necessary sooner or later to go much further and take measures for its regulation on the fishing banks offshore.

The greater number of the beam-trawlers landing fish at Aberdeen are not Scotch, but English. Last year the entire number of

trawlers which landed fish at Aberdeen was 95—37 Scottish and 58 English. Some of these, however, only called occasionally. Omitting these, and confining ourselves to trawlers which regularly came, the following table shows how their number is increasing:—

| | Number of beam-trawlers regularly landing fish at Aberdeen. | |
|---|---|---|
| | Scottish. | English. |
| 1885 . . . . . . | 18 | 29 |
| 1886 . . . . . . | 13 | 29 |
| 1887 . . . . . . | 10 | 38 |
| 1888 . . . . . . | 18 | 32 |
| 1889 . . . . . . | 20 | 30 |
| 1890 . . . . . . | 29 | 31 |
| 1891 . . . . . . | 36 | 37 |

The reason for the increased employment of English beam-trawlers in the waters off the East Coast of Scotland may be found in the statistics of the flat fish landed on the East Coast of England during recent years, which are as follows:— English beam trawlers leaving English for Scottish waters

| Year. | Turbot. | | Soles. | | Prime Fish not separately distinguished. | | Totals. | |
|---|---|---|---|---|---|---|---|---|
| | Cwts. | £ | Cwts. | £ | Cwts. | £ | Cwts. | £ |
| 1887 | 57,561 | 164,772 | 67,874 | 304,200 | 109,424 | 350,231 | 234,859 | 819,203 |
| 1888 | 48,760 | 149,151 | 52,151 | 275,770 | 105,057 | 280.070 | 205,968 | 704,991 |
| 1889 | 44,272 | 145,674 | 47,747 | 286,188 | 25,848 | 77,582 | 117,867 | 509,444 |
| 1890 | 40,763 | 149,849 | 46,187 | 302,703 | 46,137 | 116,872 | 133,087 | 569,424 |
| 1891 | 47,594 | 175,179 | 61,287 | 386,718 | 43,728 | 98,064 | 152,609 | 659,961 |

Thus, on the fishing-grounds off the East Coast of England in the course of two years, 1887–89, the soles caught have diminished by 20,127 cwts., turbot by 13,289 cwts., and other prime fish by 83,576 cwts., the total decrease in value being £309,759. Hence English trawlers are coming north in increased numbers, and probably in a few years the statistics of the flat-fish caught in Scottish waters will show a great decline.

3. *The Shore Fisheries.*—Coincident with these facts we have to face the hardly less deplorable fact of a steady and continuous decline in the value of the fisheries for shell-fish, namely, oysters, mussels, lobsters, crabs, cockles, &c.,—which form about a twenty-fourth of the gross value of the sea fisheries, or, excluding cured fish, about one-eleventh of the whole. These fisheries constitute a valuable supplementary industry, giving useful employment to the younger members of fishermen's families and the old and feeble, when they are laid aside from going out to sea. In former Reports we have shown that this process of decay is not peculiar to this country. The United States, France, Holland, &c., have all gone through the same experience; but by adequate measures for their protection Decay of shell fish and shore fisheries.

and culture the process has been not only successfully resisted, but the rich fertility of their shores in this source of wealth has been revived and even increased. We hope that the public mind of this country will soon awake to the vast importance of this instructive fact.

The steady decline in the inshore fisheries explains how it is that we are now obliged to import such vast quantities from other countries—mussels for bait from Holland, lobsters from Norway aud Canada, oysters from France, Holland, and America. This country could raise its supplies for itself if it chose to take the trouble. But the field requires to be cultivated and protected both against their own natural enemies and over-fishing, as has already been done in France, Holland, and America. It is, moreover, a field in which we do not require to fear competition, and this appears to us to be one of the chief subjects to which the attention of the future Board ought to be directed. For that purpose, however, the Board will require to be endowed with further powers. We can prohibit any mode of fishing which we consider injurious, but we cannot regulate the mesh of a net, or fix a close-time, nor provide (except in the territorial waters) that a certain portion of the sea shall periodically be protected, nor enact regulations to prevent the capture of immature fish.

The Sea Fisheries Regulation Act, which was passed for England in 1888, empowers a local Fisheries Committee for a sea fisheries district to pass byelaws—'restricting or prohibiting, either absolutely 'or subject to regulations, any method of sea fishing for sea fish, or 'the use of any instrument of fishing for sea fish, and for deter-'mining the size of mesh, form and dimensions of any instrument of 'fishing for sea fish.' In any new legislation we beg to submit that similar powers should be conferred on this Board.

## 6. MARINE POLICE AND FISHERY SUPERINTENDENCE.

Vessels in Board's service.

During the past year this duty has been entrusted to the Board's cruiser 'Vigilant,' H.M.S. 'Jackal,' and H.M. Cutter Daisy, occasionally supplemented by the 'Firm,' 'Watchful,' and 'Eagle,' which were placed at the service of the Board by the Admiral Superintendent of Naval Reserves.

We continue to receive frequent complaints of the inefficiency of this service in preventing trawling within the prohibited waters, which, however, is due to no want of zeal on the part of the officers and men, but to the system under which it is conducted, the character of the vessels employed, and the smallness of the number. The 'Garland,' having her scientific work to attend to, was never intended for police duty at all, and all the other vessels, except the 'Vigilant' and 'Jackal,' and 'Daisy,' are only available for a few months in the year. The following Table (which gives the number of prosecutions in each year, and the name of the vessel instrumental in the detection of the offenders) shows that these complaints are not unfounded:—

| Year. | Prosecutions. | Vigilant. | Jackal. | Garland. | Watchful. | Eagle. | Firm. | Active. | Daisy. | Elk. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1886 | 7 | ... | ... | ... | ... | ... | ... | 2 | ... | ... |
| 1887 | 3 | ... | 1 | ... | ... | ... | ... | ... | ... | ... |
| 1888 | 3 | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 1889 | 24 | ... | 5 | ... | ... | ... | ... | ... | ... | ... |
| 1890 | 38 | ... | ... | 4 | 19 | ... | ... | ... | ... | ... |
| 1891 | 22 | 1 | 1 | 8 | ... | ... | 3 | ... | ... | ... |
| Total | 97 | 1 | 7 | 12 | 19 | ... | 3 | 2 | ... | ... |

The 'Vigilant' and 'Jackal' did very well when their main function was to keep foreigners off the territorial waters, settle disputes amongst fishermen, prevent breaches of the peace, and enforce the provisions of the statutes as to signal lights, and lettering, numbering, and registering boats engaged in the fishing industry. But now that Parliament has passed an Act drawing a line round the entire coast, and authorised the Board to close such extensive waters as the Firth of Forth, Aberdeen Bay, and the Moray Firth, inside of which every trawler caught fishing is to be punished as a trespasser, the old establishment of former years cannot reasonably be expected to suffice.

Additional cruisers necessary.

We are aware that it is a difficult problem how to provide adequate protection, except at much cost, along an extensive sea board, when it is so easy for trawlers to receive notice by telegraph of the movements of the Government vessels, and regulate their operations accordingly. But we again respectfully represent that at the present day the 'Vigilant,' which is an old sailing cruiser, is not worth the money which she costs to keep up, and that she should be superseded by a steam vessel. Besides the 'Jackal' an efficient gun-boat should be placed at our disposal all the year round, and each of the three vessels furnished with a steam launch for special service.

## Injuries done by Trawlers or other Fishing Boats to the Boats or Gear of Fishermen.

Damage to lines.

The number of complaints investigated and reported on by the Board's fishery officers and commanders of fishery cruisers last year was 88, as compared with 70 in 1890, 79 in 1889, and 128 in 1888. Thirty-six complaints against trawlers, 9 against fishing boats, and 1 against a dredger for damaging lines of other fishing boats were investigated and reported on by the Board's officers. Of these, 41 were satisfactorily settled on the basis of the officers' reports, 2 were cases of mistaken identity, while in one case the parties refused to accept the officers' decision, and 2 cases remained unsettled. Six cases

Collisions.

Damage to nets, boats, and sailing gear.

of collision and consequent damage to boats were reported on, and satisfactorily settled. There were 15 complaints against fishing boats for damage to nets, 6 for the same offence against trawlers, and 4 against other vessels, which, together with 11 complaints of damage to boats and sailing gear, were all settled to the satisfaction of the different persons concerned.

Damage sustained outside and inside territorial waters.

Sixty-three of the total number of cases arose from damage sustained outside the territorial waters, while 24 occurred inside; and in one case the locality was not ascertained. Of these, the Board's fishery officers investigated 78, the commander of the 'Vigilant' cruiser 4, the commander of H.M.S. 'Jackal' 3, and the commander of H.M.S. 'Watchful' 3.

Results satisfactory.

It is satisfactory to note that only in 3 cases was it found necessary to have recourse to legal proceedings, and in these cases the Sheriff found none of the accused parties liable for the damage done, his decisions being in accordance with the findings in the officers' reports. A great deal of expense was thus saved to the fishermen through the instrumentality of the Board's officers. Damages amounting altogether to upwards of £260 were awarded.

Amount of damages.

Fishermen whose boats or gear are damaged should complain to officers.

The Board would here repeat the recommendation which they made in the last Report, that any fisherman whose boats, nets, lines, or fishing gear are damaged by a trawler or other fishing boat, should immediately complain to the fishery officer of the district, or to any of the commanders of the superintending cruisers, who will, in terms of Act of Parliament, inquire into the circumstances of the complaint, and furnish a report setting forth, as far as possible, the particulars thereof, stating the amount of damage done, and who is in fault. In the event of both parties being satisfied with the report, the matter may be settled in terms thereof; but if an arrangement is not made, then the party who has sustained damage may take the case into court, and have the question tried and decided by the Sheriff, the officer's report forming part of the evidence.

Great importance of this matter to fishermen.

This recommendation is all the more pressed upon fishermen, as by such inquiries and reports they are usually enabled to get a settlement of the damage they sustain without having recourse to legal proceedings, or incurring any expense; and, indeed, it would appear that the cases already decided have had the effect of making trawlers and other fishing boats more careful to avoid doing injury to each other.

## BRANDING OF HERRINGS.

Rearrangement of Crown brands.

Since the year 1809, when the former Board were entrusted with the administration of the Government Crown Brand for cured herrings, the brand has from time to time undergone many changes, to suit the requirements of the trade and of the public; and, in order to still further meet the wants of Continental buyers who consumed 98·96 per cent. of all the herrings branded in Scotland last year, the Board in 1890 rearranged the different crown brands, and issued revised regulations for the guidance of their officers and the trade.

Revised regulations issued.

During the season of 1891, 270,701 barrels of herrings were pre-

sented to the Board's officers for the various brands; and, after inspection, 256,318 barrels were branded. The remaining 14,383 barrels—5·31 per cent. of the quantity presented—were rejected as not reaching the required standard. Of the barrels branded last year, 4,672 were 'Large Full,' 115,064½ 'Full,' 64,481½ 'Matie Full,' 54,983½ 'Spent,' and 17,116½ 'Mixed.' The amount of brand fees received by the Board was £4271, 19s. 4d. Quantity of herrings branded in 1891 and 1890.

Appendix A., No. IV., shows the total number of barrels of white herrings which were branded in Scotland last year, and of the brandings in each district. This Appendix also shows the respective number of barrels which were branded 'Large Full,' 'Full,' 'Matie Full,' 'Spent,' and 'Mixed,' and the amount of brand fees collected. Particulars of herrings branded.

From this Appendix it will be seen that, as compared with the results for 1890, there was a decrease in 1891 of 119,962 barrels in the total quantity of herrings branded, there being a decrease in all the brands with the exception of the 'Spent' which exhibits an increase of 3,540½ barrels. It is important, however, to state that the proportion of cured herrings which received the brand has steadily increased during the last 50 years, in periods of 10 years, by 30·34, 21·54, 66·35, and 4·95 per cent. respectively; and the average for the last 10 years was 475,721½ barrels. As regards the comparatively small number of barrels crown branded last year, it may be stated, that in the early part of the season many small herrings were taken which could not be branded, and the majority of these herrings were sold chiefly to Russian buyers at very low prices. A new trade mark for unbranded herrings marked 'Medium Fulls' was also introduced by a large number of curers who use the crown brand. The fishcuring trade preferred the various crown brands a quarter of an inch lower than was recommended by the Board through the deputation which visited the East Coast. Meanwhile, it is not thought advisable to change the present regulations, as the majority of the trade is satisfied with them; and it is computed that but for this at least 80,000 to 100,000 barrels more would have been crown branded. It may be mentioned that the new regulations issued by the Board have effected an improvement in the selection of unbranded herrings, even among the best trade marks; and the prices of fresh herrings have thus been materially enhanced all round. Decrease in 1891, as compared with 1890. Increase during last fifty years. Reasons for comparatively small number of barrels branded. No change in present regulations advisable. Regulations have improved selection among trade marks, and increased the value of fresh herrings.

In rearranging the different brands, and framing the new branding regulations, as well as in fixing the basket measures noticed in former reports, we have been greatly indebted to Mr Johnston's practical knowledge as a curer, which he has freely placed at the disposal of the Board. At great personal inconvenience, he twice visited the Continent in order to investigate the subject in the foreign markets, and it is due to him to state that in all these matters he spared neither time nor trouble in devising such improvements as would be just and beneficial. That he has succeeded is proved by the fact that the past has been the first year for many years in which no communication has been received by the Board either from home or abroad, finding fault with herrings branded with the crown brand.

Branding in Northumberland discontinued.

From the year 1809 (when the brand was first administered) up to 1889, it had all along been the practice of the Board to brand cured herrings on the coast of Northumberland. In the latter year, however, certain difficulties arose which cast doubt upon the legality of their continuing to do so; and, in consequence thereof, the Board resolved to discontinue branding at the English stations from and after 1st January 1890. This step caused great dissatisfaction among fish-merchants, fish-curers, and others interested; and strong representations were received from Lowestoft, North Sunderland, Leith, and other stations, urging that the withdrawal of the official brand would be most disastrous both to fish-curers and fishermen, and that the contemplated action of the Board would add greatly to the difficulties against which the fishing industry had to contend, and requesting the Board to reconsider their decision. The Board thereupon resolved to ask the Secretary for Scotland to get their powers extended to the English stations; and an Act to amend the law respecting the branding of herrings on the coast of Northumberland was accordingly passed through Parliament, by which 'the powers of the Scotch Fishery Board and 'of their officers with respect to the branding or marking of 'barrels or half barrels under any Act, and of branding or marking 'any measure specified in any Act, shall extend to the administrative 'county of Northumberland, and to the sea adjoining the same, and 'within the exclusive fishery limits of the British Islands, and the 'provisions of any Act in regard to the exercise of those powers 'and the enforcement of any penalties thereunder shall apply 'accordingly.'

Great dissatisfaction.

Act passed to amend the law as to branding of herrings on coast of Northumberland.

Branding resumed.

Under these powers the Board resumed branding on the Northumberland Coast during 1891.

## SUMMARY OF HERRING FISHERY.

### Cured Fish.

### I. *East Coast.*

Number of fish-curing establishments on East Coast.

On the east coast of Scotland during the herring fishing season of 1891 there were 632 herring-curing establishments, carried on by 546 fishcurers, against 630 establishments and 572 fishcurers in 1890. The decrease of 26 in the number of curers is accounted for by the facts that 30 new fishcurers embarked in the trade and 56 abandoned it. The returns of herrings cured (which are exclusive of those sprinkled or slightly salted), when compared with those for 1890, show a collective increase in six districts of 22,347½ barrels, and a collective decrease in eleven districts of 287,009 barrels, thus giving a net decrease of 264,661½ barrels. The six districts which contributed to the increase were Leith, Anstruther, Buckie, Findhorn, Orkney, and Shetland; while those districts which exhibited the largest decrease were Fraserburgh, Wick, Peterhead, and Aberdeen, to the extent of 93,126, 65,552, 65,108, and 18,805 barrels respectively. Such a decrease at

Six districts show an increase and eleven a decrease in quantity of herrings cured.

the four principal stations in one year is very unusual. The decreases in the remaining seven districts were much smaller.

The returns of herrings cured on the whole of the east coast of Scotland in the fifty years preceding 1891, on the average of each period of ten years, show a continuous large increase up to last year.

East Coast fishing of fifty years preceding 1891.

The particulars are as follow:—

| Periods of Ten Years. | Yearly Average of Barrels cured. |
|---|---|
| 1841 to 1850 inclusive, | 477,366½ |
| 1851 „ 1860 „ | 507,376½ |
| 1861 „ 1870 „ | 514,304¾ |
| 1871 „ 1880 „ | 767,944½ |
| 1881 „ 1890 „ | 1,111,744 |

Yearly average of barrels cured in periods of ten years.

Barrels cured in 1891, 858,646

## II. *West Coast.*

The returns for the west coast show that the total quantity of herrings cured there in 1891 (exclusive of those sprinkled or slightly salted) was 267,426 barrels, as compared with 181,295½ barrels in 1890. The large increase which these figures exhibit is accounted for by the takes in the districts of Stornoway, Loch Broom, Loch Carron and Skye, Campbeltown, Inveraray, and Rothesay, which show a total increase of 88,354½ barrels; while in only two districts is there a decrease,—amounting to 2,224 barrels,—thus giving a net increase for the whole west coast of 86,130½ barrels. Stornoway, as in the previous year, contributed the greater proportion (67,549½ barrels) of the increase; while there was also an increase of 12,592 barrels at Campbeltown, and of 6,436 barrels at Loch Carron and Skye. No herrings have been cured at Greenock during the last six years, and comparatively few were cured last year at Ballantrae, Rothesay, or Inveraray,—the great bulk of the herrings caught at the Clyde stations being despatched to the home markets for immediate use, in a fresh or slightly salted condition. Occasionally, however, large quantities of these fresh herrings were prepared as kippers. Last year the shoals of herrings on the west coast were found in greatest abundance in the districts of Stornoway, Loch Carron and Skye, Campbeltown, and Inveraray; and, as in 1890, large catches of herrings of excellent quality were obtained in Loch Fyne, Kilbrennan Sound, Loch Gruinard in Islay, the sea lochs in Skye, Loch Seaforth in Lewis, Loch Hourn, and the North Minch. While the fishing was in progress, seven large steamers were specially employed in carrying herrings from Stornoway to Scottish and English ports for distribution throughout the country; and a large number of small swift steamers was similarly employed carrying herrings to market from the districts of Loch Carron and Skye, Fort William, Campbeltown, and Inveraray.

Total increase in herrings cured on West Coast.

Six districts show an increase and two a decrease.

General view of fishing.

Steamers employed for distribution of herrings throughout the country.

West Coast fishing for fifty years preceding 1891.

In the fifty years preceding 1891, on the average of each period of ten years, the returns of herrings cured on the West Coast exhibit (except during the period from 1871 to 1880) a large continuous increase, the particulars being as follow:—

Yearly average of barrels cured in periods of ten years.

| Periods of Ten Years. | Yearly Average of Barrels Cured. |
|---|---|
| 1841 to 1850 inclusive, | 67,682¾ |
| 1851 „ 1860 „ | 91,698¼ |
| 1861 „ 1870 „ | 183,033½ |
| 1871 „ 1880 „ | 146,974½ |
| 1881 „ 1890 „ | 225,276 |

Barrels cured in 1891, 267,426.

Increase in 1891 on 1890 and on average for preceding fifty years.

The quantity of herrings cured in 1891, when compared with that for 1890, shows an increase of 47·5 per cent.; when compared with the average for the preceding ten years, an increase of 18·71 per cent.; for twenty-five years, an increase of 39·82 per cent.; and for fifty years, of 87·09 per cent.

## III. *Both Coasts.*

Quantity of herrings cured in each of the twenty-six districts.

Appendix A., No. I., shows the total quantities of all the herrings cured in 1890 and 1891 in each of the twenty-six districts embracing the whole coasts of Scotland, with the respective increases or decreases in the latter year.

Total quantity cured.

The total quantity of herrings cured in 1891, in the twenty-six districts, was 1,126,072 barrels. Of these, 45,613 barrels were cured on board vessels; while of the 1,080,459 barrels cured on shore, 971,815 barrels were cured gutted, and 16,237 barrels ungutted; 76,824 barrels were kippered, 3,646 barrels prepared as bloaters or red herrings, and 11,937 barrels preserved in tins.

Decrease in 1891 as compared with 1890 but an increase on the average for the preceding fifty years.

These figures show a total decrease, when compared with those for 1890, of 178,531 barrels; but the returns for the fifty years preceding last year, on the average for each period of ten years, show a continuous large increase, regarding which particulars will be found in the following tabular statement:—

Yearly average increase in periods of ten years.

| Period of Ten Years. | Average Number of Barrels Cured Yearly in each Period. | Increases in Average Number of Barrels Cured Yearly in each Period. | Increases per cent. in Average Number of Barrels Cured Yearly in each Period. |
|---|---|---|---|
| 1841 to 1850 inclusive, | 552,933 | ... | ... |
| 1851 ,, 1860 ,, | 601,270½ | 48,337½ | 8·74 |
| 1861 ,, 1870 ,, | 686,360 | 85,089½ | 14·15 |
| 1871 ,, 1880 ,, | 914,919 | 228,559 | 33·3 |
| 1881 ,, 1890 ,, | 1,337,020 | 422,101 | 46·35 |
| Barrels Cured in 1891, . 1,126,072. | | | |

From the above statement some idea may be formed of the great importance and value of the herring fishery to the people of Scotland. Although the total quantity of herrings cured in 1891, when compared with the average for the preceding ten years, shows a decrease of 15·77 per cent., yet it shows an increase of 7·8 per cent. when compared with the average for the preceding twenty-five years, and of 37·57 per cent. for the preceding fifty years. The extraordinary development of this fishery appears even more remarkable than is shown by these returns when it is remembered that in the year 1809, when the returns were first compiled by the former Board, the total number of barrels cured was only 90,185½; while the number cured last year, as shown above, was 1,126,072.

Value of herring fishery to people of Scotland.

Decrease per cent. in 1891 from average for preceding ten, and increase on twenty-five and fifty years.

Great development of fishery since 1809.

## Herrings Cured on Board Vessels and on Shore.

Appendix A., No. II., shows the number of vessels fitted out in Scotland last year for the herring fishery; the districts from which they were fitted out; their tonnage and the number of men; the quantity of netting, salt, and empty barrels shipped; and the total number of barrels of white herrings cured on board; distinguishing those cured gutted from those cured ungutted.

Herrings cured on board of vessels.

For a number of years past, this branch of the industry, which is carried on chiefly in the sea lochs on the west coast, has been gradually declining. The results of 1891, however, although much under those of some years ago, when from 90 to upwards of 300 vessels were engaged, show a slight increase over 1890 in the number of vessels fitted out, and a considerable increase in the quantity of herrings cured on board. Efforts have been made during recent years to revive the industry on the east coast, but so far with little success, as the herrings have been found in greatest abundance on the inshore grounds; and no vessels were fitted out on the east coast in 1891 for this purpose. On the west coast, however, sixty-two vessels were employed, making seventy-one voyages, and curing 45,613 barrels on board; being an increase of two vessels and 15,620 barrels over the figures for 1890.

This branch of industry declining.

Appendix A., No. III., shows the total number of barrels of white herrings cured or salted in Scotland last year, both on board of vessels and on shore, and the districts in which they were taken and cured, distinguishing the herrings cured gutted from those cured ungutted; and also the quantities of herrings cured as kippers, bloaters, or red herrings, or preserved in tins.

Total quantity of herrings cured in vessels and on shore.

The herrings cured as kippers, bloaters, or red herrings, or preserved in tins, are distinguished in this Appendix from those cured in the ordinary manner.

## HERRINGS EXPORTED.

Quantity of cured herrings exported.

The total quantity of cured herrings exported from Scotland in 1891 amounted to 852,715¾ barrels, against 985,670½ barrels in 1890, being a decrease of 132,954¾ barrels, or 13·79 per cent.

Places to which exported.

From the subjoined statement it will be observed that the total exports to the Continent in 1891 amounted to 796,345 barrels, of which 31·97 per cent. were crown branded. There was thus a decrease of 144,909 barrels, as compared with 1890; but the exports to Ireland and to places out of Europe show an increase of 6817½ barrels and 5136¾ barrels respectively. Of the last, the greater proportion was sent to America in barrels, half-barrels, quarter-barrels, and in smaller casks. A considerable number of the barrels and half-barrels were crown branded; but about half the total export to America consisted of repacked herrings in the smaller sizes of barrel. The chief ports from which these herrings were shipped were Greenock, Leith, Montrose, and Aberdeen. Of the exports to Germany, the greatest proportion, amounting to 314,945 barrels, was sent to Stettin—the principal herring market in that country—being 44,302½ barrels fewer than in 1890.

Exports in 1890 and 1891 compared.

The following Table shows the number of barrels of cured herrings exported from Scotland in the years 1890 and 1891:—

| Years. | To Ireland. | To the Continent. | To Places out of Europe. | Total. |
|---|---|---|---|---|
| 1890, | 29,639½ | 941,254 | 14,777 | 985,670½ |
| 1891, | 36,457 | 796,345 | 19,913¾ | 852,715¾ |
| Increases in 1891, | 6,817½ | ... | 5,136¾ | ... |
| Decreases in 1891, | ... | 144,909 | ... | 132,954¾ |

Increase during last fifty years.

The returns of the export of cured herrings for the fifty years preceding last year, on the average of each period of ten years, show that there has been a continuous increase, during each decade, of 26·39 per cent., 15·07 per cent. 52·58 per cent., and 47·44 per cent. respectively.

Particulars as to herrings exported.

Appendix A., No. V., shows the total number of barrels of white herrings exported from Scotland last year, and the districts from which they were exported; distinguishing the export to Ireland, to the Continent, and to places out of Europe; and distinguishing also herrings crown branded from herrings unbranded, and giving the quantity of herrings repacked. To this Table is appended a supplementary note, showing the ports or places to which the herrings exported to the Continent were shipped, and the total quantity exported to the Continent.

Appendix A., No. VI., gives an abstract of the total quantity of white herrings cured, branded, and exported, year by year, *in so far as brought under the cognizance of the fishery officers* from 1st January 1875 to 31st December 1891, distinguishing the export to Ireland, to the Continent, and to places out of Europe. Herrings cured, branded, and exported, 1875 to 1891.

## COD, LING, AND HAKE FISHERY.

### Cured Fish.

The returns of the cod, ling, and hake fishery, which was successfully prosecuted during 1891, show a considerable increase over the average of preceding years. The total quantity landed was 803,317 cwts., of which 37,181 cwts. were taken by beam-trawlers. These figures show an increase of 54,187 cwts. and 4192 cwts. respectively over those for the preceding year. Cod, ling, and hake fishery. Quantity landed in Scotland in 1891.

Of the above total quantity, nearly one-half was consumed in a fresh state,—the remainder, which amounted to 4,247,407 fish, being cured. These produced 146,661 cwts. of dried cod, and 8886 barrels cured in pickle, being an increase on 1890 of 132,633 fish, 1395 cwts. dried, and 2700 barrels pickled. Quantity used fresh and cured.

Sixty-four vessels and boats were fitted out for this fishery,—their takes amounting to 888,480 fish, which, when cured dried, weighed 24,143 cwts., as against 51 vessels and boats, 637,380 fish, and 15,533 cwts. respectively in 1890. Thirty-one of the above vessels belonged to Shetland, 25 to Orkney, and 8 to Fraserburgh. Vessels fitted out for this fishery. Fish taken, and cured on board

As usual, a few Swedish vessels were engaged in this fishery last summer off the north isles of Shetland, and landed some fish at Balta Sound, disposing of them to local curers. The great bulk of their catches, however, was carried to Swedish ports for the supply of their own markets. Swedish vessels.

Some of the largest Shetland fishing vessels were fitted out about the first week of March for the Faroe fishing; but, owing to the stormy weather which prevailed, they were not very successful. Later in the season they went to Rockall and Iceland; and, while at the former place, only a few fish were taken, the fishing at the latter was very prosperous, and the boats returned with full cargoes. The smaller vessels, including eleven belonging to England, prosecuted the fishing during the season upon the Shetland coasts, and obtained good average catches, which were disposed of to local curers. The fishing was also successfully prosecuted at Balta Sound, and at a few of the west side stations, by fifty East Coast boats, two of which landed in one week at Ronanessvoe 31 tons of fish, a large proportion of which was halibut. The average earnings of these 50 boats amounted to £150, and many of the boats belonging to the district were equally successful. Large Shetland vessels at Faroe, Rockall, and Iceland. Successful fishing at Iceland. Good catches obtained by small boats. Success of East Coast boats.

Returns compiled for over seventy years.

Fish landed in Shetland in excess of that of any other District.

Quantity cured there in 1891.

Quantity cured in Orkney and Stornoway districts.

Quantity of cod pickled in Wick.

It is now more than seventy years since the first returns of the cod, ling, and hake fishery were compiled, and during that long period the quantity of these fish landed in Shetland has far exceeded that of any other district in Scotland. Last year 1,793,971 fish were cured there, which, when dried, weighed 59,135 cwts., being 42·23 per cent. of the total number, and 40·32 per cent. of the total quantity, cured in Scotland. Stornoway and Orkney are next in importance,—the former having 22,225 cwts. of fish dried and 150 barrels pickled, and the latter 21,271 cwts. dried and 281 barrels pickled. Wick, as was the case in the preceding year, had the greatest quantity of pickled cod,—amounting to 5085 barrels, or 57·22 per cent. of all the cod pickled in Scotland.

Industry might be much more developed.

Productiveness of fishing grounds in some districts.

It has often been remarked by those who are best informed on the subject that this fishery is capable of great development, especially in the waters round the islands of Orkney and Shetland, and the Outer Hebrides. As illustrating the productiveness of some of the fishing grounds in these districts, it may be stated that one day last season on the north-west side of Shetland, about 28 miles off land, in 120 fathoms of water, a boat took 103 cwts. of halibut and 112 cwts. of ling. There are also other grounds in less depth of water around the Orkney and Shetland Islands and along the west coast where cod are found in considerable abundance, but they are not fished to any extent.

Fish packed in ice for despatch to the southern markets.

Owing to the great demand for fresh fish, large quantities of cod and ling were packed in ice at Shetland, and other outlying districts, for transport to the southern markets.

Quantity of fish cured in each of the last five years.

The following is a statement of the total quantity of cod, ling, and hake cured in each of the last five years:—

| Years. | Cured Dried. Cwts. | Cured in Pickle. Cwts. |
|---|---|---|
| 1887, | 122,832 | 7,538 |
| 1888, | 137,216 | 7,052 |
| 1889, | 145,661 | 6,920 |
| 1890, | 145,266½ | 6,186 |
| 1891, | 146,661 | 8,886 |

Cod, ling, and hake cured and exported in 1890 and 1891.

The particulars of the cod, ling, and hake cured dried and exported, and cured in pickle, when compared with 1890, are as follows:—

| Years. | Total Quantity Cured. | | Total Quantity Cured Dried, and Exported. | | | |
|---|---|---|---|---|---|---|
| | Dried. | In Pickle. | To Ireland. | To the Continent. | To Places out of Europe. | Total. |
| | Cwts. | Barrels. | Cwts. | Cwts. | Cwts. | Cwts. |
| 1890, | 145,266½ | 6,186 | 64,599 | 18,390 | 15,786 | 98,775 |
| 1891, | 146,661 | 8,886 | 51,668 | 20,900 | 5,504 | 78,072 |
| Increases in 1891, | 1,394½ | 2,700 | ... | 2,510 | ... | ... |
| Decreases in 1891, | ... | ... | 12,931 | ... | 10,282 | 20,703 |

From the above return it will be observed that there is an increase in the quantity cured and in the exports to the Continent, but a large decrease in the quantity sent to Ireland and to places out of Europe. The falling off exhibited in the last two cases is to a large extent accounted for by the fact that better markets have been found at home; and this, too, explains why no pickled cod have been exported during the last three years. Since 1890 the prices obtained for these fish have advanced 16·6 per cent. As mentioned in last report, the mode of sending dried fish to the Spanish markets has entirely changed within the last few years. Cargoes are not now shipped direct from this country as formerly, but the fish are forwarded in small lots—generally in cwt. packages—through agents at the principal ports in this country.

Increase in quantity cured and in exports to Continent.

Decrease in exports to Ireland and to places out of Europe.

Rise in prices.

Appendix B., No. I., shows the total quantity of cod, ling, and hake taken, both by vessels and boats, at the cod and ling fishery in Scotland, and cured last year; and the districts in which they were cured; distinguishing the fish cured dried and the fish cured in pickle. A supplementary note gives particulars regarding the cod, ling and hake cured on board vessels.

Total of cod, ling, and hake cured in vessels and on shore.

Appendix B., No. II., shows the total quantity of cod, ling, and hake exported from Scotland last year; and the districts from which they were exported; distinguishing the export to Ireland, to the Continent, and to places out of Europe; and also whether cured dried or cured in pickle.

Cod, ling, and hake exported.

Appendix B., No. III., gives an abstract of the total quantity of cod, ling, and hake cured and exported, *in so far as brought under the cognisance of the fishery officers*, from 1st January 1875 to 31st December 1891.

Cod, ling, and hake cured and exported, 1875 to 1891.

## TOTAL QUANTITY OF FISH LANDED.

Appendix C., No. I., is a comparative statement of the total quantity and value of the different kinds of white and shell-fish landed in each of the twenty-six fishery districts of Scotland, in the years 1891 and 1890, distinguishing the quantities and the values thereof.

White and shell-fish landed in the last two years.

The total quantity and value of white fish landed last year were 5,434,206 cwts. and £1,762,494 respectively, while the value of shell-fish landed was £76,165, giving a total value of £1,838,659. Thus, while the quantity of white fish landed, when compared with that for 1890, shows a decrease of 430,282¼ cwts., the value thereof has increased by £137,148, and the value of the shell-fish by £7552,—the gross increase in value being £146,700. The average price per cwt. of white fish in 1891 was 6s. 5¾d., against 5s. 6½d. per cwt. in 1890.

Quantity and value of white fish landed and value of shell fish.

From the above mentioned Appendix it will be observed that, as compared with the results for 1890, there is an increase in the quantity landed of mackerel, cod, ling, sole, other kinds of white fish, and all the different varieties of shell-fish, except under the heading of 'other kinds of shell-fish,' but a decrease of herring, sprat, torsk, saithe, haddock, whiting, turbot, halibut, flounder, eel, and skate.

Quantity and value of fish landed by beam trawlers.

Appendix C., No. II., is a statement of the total quantity and value of the different kinds of white fish taken by beam-trawl vessels, and landed in different districts in Scotland last year.

Increase on both.

An examination of this statement shows that the total quantity of all kinds of white fish landed last year by beam-trawl vessels was 323,047½ cwts., valued at £226,720, against 291,812 cwts., valued at £203,620 in 1890. The fish landed by beam-trawl vessels represent 17·11 per cent. of the total quantity landed in Scotland (exclusive of herrings, sprats, sparlings, and mackerel) and 27·12 per cent. of the value. The respective percentages in 1890 were 15·61 and 25·62, while in 1889 they were 13·53 and 21·46. Thus higher prices were obtained for some kinds of trawled fish, which may be explained by the fact that trawlers capture a larger proportion of highly priced fish, such as turbot, plaice, and soles. Only three years have elapsed since separate returns for trawled fish were first compiled; but during that short period both the quantity and value of the fish landed by trawlers show a yearly increase. In 1889 the value of such fish was £158,306, in 1890 it was £203,620, and in 1891 £216,720, but, as already stated, there has been a very great increase in the number of trawlers, especially English ones.

Higher prices obtained for trawled fish.

Returns of fish landed, collected by Board's officers.

These statistics have been compiled from information collected by the Board's officers in the twenty-six districts, and by a number of correspondents resident at different harbours and creeks.

Published monthly.

As early in each month as possible, a statement is published of the total quantity and value of the different kinds of white and shell-fish landed during the preceding month, distinguishing the quantities landed in each district, and the values thereof; and a copy of this statement is regularly sent to the Board of Trade, and published in their Monthly Journal.

Dutch mussels landed on East Coast.

During the past two or three years considerable quantities of Dutch mussels have been landed on the East Coast by special steamers chartered for the purpose. This supply, however, cannot be depended upon in future.

[FISH SOLD

## Fish Sold for use in a Fresh State.

The following statement shows the total quantity and value of white fish landed in Scotland and sold for use in a fresh state, or disposed of in the localties where captured, for the last eight years, during which time these statistics have been collected. It also shows the value of shell-fish landed for the same period.

Fish sold for use in a fresh state. Details thereof for last eight years.

| Years. | Total Quantities of White Fish used Fresh. | Total Values of White Fish used Fresh. | Total Values of Shell Fish. | Gross Total Values. |
|---|---|---|---|---|
| | Cwts. | £ | £ | £ |
| 1884 . . . . . | 1,494,042 | 716,295 | 80,939 | 797,234 |
| 1885, . . . . . | 1,725,459 | 737,824 | 89,193 | 827,017 |
| 1886, . . . . . | 1 714,453 | 685,973 | 73,287 | 759,260 |
| 1887, . . . . . | 1,877,998 | 694,091 | 67,315 | 761,406 |
| 1888, . . . . . | 1,901,439 | 717,057 | 71,728 | 788,785 |
| 1889, . . . . . | 1,977,357 | 744,351 | 63,201 | 807,552 |
| 1890, . . . . . | 2,289,803½ | 900,416 | 68,613 | 969,029 |
| 1891, . . . . . | 2,207,753 | 925,821 | 76,165 | 1,001,986 |
| Totals, . . . . | 15,188,304½ | 6,121,828 | 590,441 | 6,712,269 |

From the above statement it will be seen that the supply of fresh fish to the home markets has, on the whole, been steadily increasing year by year, the only two exceptions being 1886 and 1891, when there was a decrease on the preceding years of 11,006 cwts. and 82,050½ cwts. respectively. When, however, the take for 1891 is compared with the average for the preceding seven years, it shows an increase of 19·05 per cent. in the quantity and of 24·72 per cent. in the value. There is also an increase on the value of shell-fish landed of 3·67 per cent.; thus giving an increase on the value of both of 22·82 per cent.

Supply of fresh fish steadily increasing.

Comparison of 1891 with preceding seven years.

Notwithstanding the very large supply of fresh fish forwarded to the home markets, and the competition with foreign fish there, the demand was generally good and the prices obtained by fishermen last year were higher than in 1890—the average being 8s. 4½d. per cwt., against 7s. 10½d. in 1890, and 7s. 6¼d. in 1889; while the average rate per cwt. for the preceding seven years was 8s.

Prices higher in 1891 than in preceding year

Appendix C., No. III. is a statement by districts of the total quantity and value of white and shell fish taken in Scotland, and sold for use in a fresh state, or consumed in the localities where taken, in the year 1891.

## OYSTER AND MUSSEL FISHERY ORDERS.

By the Sea Fisheries (Scotland) Amendment Act of 1885 all the powers and duties of the Board of Trade, in so far as they could be exercised in Scotland, in respect of oyster and mussel fisheries, were transferred to this Board, who drew up a set of

Powers and Duties of Board of Trade transferred to Fishery Board.

regulations for the instruction and guidance of persons applying for fishery orders, which they believed could be granted at much less expense than formerly, thus affording every facility for the cultivation of these fisheries.

West Loch Tarbert Oyster and Mussel Fishery Order.

Shortly after this transference several applications for fishery orders were received by the Board, and one from Messrs William Hay and others of Tarbert, Loch Fyne, was favourably entertained. The area proposed to be included in the Order was situated on the sea-bed of West Loch Tarbert, in the County of Argyll. After the necessary preliminaries had been completed, the Board made an Order in the form proposed (with slight emendations), which was afterwards confirmed by Act of Parliament. Of other applications since received, one has been approved by the Board, and also confirmed by Parliament, viz., that from Colonel John Wingfield Malcolm, yr., of Poltalloch, M.P., and Major Duncan Campbell of Inverneil and Ross, for the establishment and maintenance of a Several Oyster and Mussel Fishery at Loch Sween in the County of Argyll, while two others are at present in the preliminary stages, —one from Maclaine of Lochbuie, for a fishery at Loch Spelve, Argyllshire, and the other at the instance of Mrs Ogilvy of Barcaldine, for a fishery at Loch Creran, Argyllshire. In the latter instance, after the Board had fully considered the memorial made to them, they decided to proceed with the case. The procedure required by the regulations having been complied with, Mr Young, then Inspector of Salmon Fisheries, was appointed by the Board to hold an inquiry regarding the proposed Order, and to take evidence. A sitting was accordingly held at Oban; and the evidence taken, together with Mr Young's report recommending that the Order be granted, was laid before the Board. The report being approved of, an Order was made, but the final arrangements necessary before it can be confirmed by Parliament have not yet been completed. Mr Young's report, together with the evidence taken by him, is given under Appendix G.

Application for Oyster and Mussel Fishery Order for Loch Sween, approved by Board and confirmed by Parliament.

Applications for Orders for Loch Spelve and Loch Creran.

Board proceed with latter case.

Evidence taken by Mr Young, who recommended that Order be granted.

Order made.

[PRODUCE

## PRODUCE AND VALUE OF THE SEA FISHERIES OF SCOTLAND, EXCLUSIVE OF SALMON.

Total quantity and value of fish landed in 1890 compared with 1891.

The following is a statement of the total quantity and value of the different kinds of white and shell-fish landed in Scotland in the year 1891, compared with 1890:—

White fish landed.

| | *Total quantities and values of White Fish landed in* 1891. Cwts. | | *Increase in* 1891. Cwts. | *Decrease in* 1891. Cwts. |
|---|---|---|---|---|
| Herrings, . . | 3,539,623½ | £923,754 | ... | 440,739¼ |
| Sprats, . . | 5,379½ | 303 | ... | 8,697½ |
| Sparlings, . . | 232½ | 1,253 | ... | 14½ |
| Mackerel, . . | 1,734 | 1,452 | 796 | ... |
| Cod, . . . | 514,176½ | 188,611 | 65,234½ | ... |
| Ling, . . | 180,089 | 57,326 | 10,443 | ... |
| Torsk (Tusk), . | 7,624 | 1,256 | ... | 956 |
| Saithe (Coal Fish), | 101,428 | 13,218 | ... | 20,534 |
| Haddocks, . . | 726,287 | 375,557 | ... | 27,367 |
| Whitings, . . | 71,076 | 29,489 | ... | 4,446 |
| Turbot, . . | 5,015½ | 17,215 | ... | 539 |
| Halibut, . . | 19,164¾ | 17,161 | ... | 1,067 |
| Soles (Lemon Soles), | 17,739¾ | 30,223 | 1,088½ | ... |
| Flounders, Plaice, and Brill, . | 78,776½ | 67,103 | ... | 2,532½ |
| Eels, . . . | 11,846½ | 6,184 | ... | 2,229½ |
| Skate, . . | 47,076 | 11,513 | ... | 6,688 |
| Other kinds of White Fish, . | 106,937 | 20,876 | 7,966 | ... |
| Total quantity & value of White Fish landed, . | 5,434,206 | £1,762,494 | 85,528 | 515,810¼ |
| Deduct increase, . | | | ... | 85,528 |
| Net decrease in 1891, . | | | ... | £430,282¼ |

Shell fish landed.

| *Total values of Shell Fish landed—* | | *Increase in* 1891. |
|---|---|---|
| Oysters, . . . . . . | £1,568 | £42 |
| Mussels, . . . . . . | 14,329 | 3,128 |
| Clams, . . . . . . | 3,350 | 39 |
| Lobsters, . . . . . . | 31,668 | 3,328 |
| Crabs, . . . . . . | 15,295 | 727 |
| Other kinds of Shell Fish, . . | 9,955 | 288 |
| Total value of Shell Fish landed, | £76,165 | £7,552 |
| Total value of White Fish landed, brought down, . | 1,762,494 | |
| TOTAL Value of the Sea Fisheries of Scotland, exclusive of Salmon, for the year 1891, . . | £1,838,659 | |
| Ditto for the year 1890, . | 1,691,959 | |
| Increase in year 1891 on 1890, . . . . | £146,700 | |

Total value of sea fisheries.

*Note.*—An estimate of the value of the Salmon taken last year will be found in Part II. of this Report. It amounts to £276,776, making the grand

total value of the Sea and Salmon Fisheries of Scotland for the year 1891 £2,115,437. It should also be explained that there is spent in Scotland an amount estimated at £400,000 in curing fish,—that is, on wood, hoops, coopers' and women's wages, salt, &c.; this sum being included in the estimated gross total value of the sea fisheries of Scotland given in the Board's Reports previous to 1889.

Proportion of white fish cured.

Of the total quantity of herrings landed, as shown in the above statement, 1,126,072 barrels were cured. Of the total catch of cod, 83,144 cwts. were cured dried, and 8,886 barrels in pickle; of ling, 42,748 cwts. were cured dried; of torsk, 1,813 cwts.; and of saithe, 18,956 cwts.

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The Board have to record with regret the death of Mr Irvine of Drum, who as Sheriff of Argyll had been a member of the Board since its constitution in 1882. His place has been filled by his successor in the Sheriffdom, Mr D. M'Kechnie. Mr Graham the Secretary, and Mr Young, Inspector of Salmon Fisheries, have been obliged to retire, under the Order in Council which makes retirement from the Civil Service compulsory at the age of sixty-five. To both of these officials our warmest thanks are due for the zeal and efficiency with which they discharged the duties of their several departments. Happily, Mr Young, who is by profession a Scottish advocate, will always be ready to advise the Board when asked on legal questions relating to rights of salmon fishing—a branch of law of which, from long experience, his knowledge is extensive, and in which in past years his assistance has been invaluable. If this office is filled up, it should certainly embrace other duties, which (thanks to Mr Young's thorough inspection of Salmon Rivers) are now of much more importance—namely, mussels, oysters, lobsters, and the general superintendence and development of the inshore fisheries. On 26th April the Board unanimously passed a resolution to that effect; and if it is thought that such an appointment cannot legally be made under section 6 of the Statute, it will undoubtedly be lawful under section 4—the only difference being that in the one case it will require to be made by your Lordship, and in the other by the Board itself on your Lordship's instructions. The office of Secretary has been conferred on Mr Robertson, the chief clerk.

Before parting with Mr Young, we thought it would be for the public benefit if the various Reports which he has made during his tenure of office to your Lordship or the Board, were collected and printed with a suitable Index. They occupy, when bound together, a volume of more than 800 pages, with a number of maps and plans, and Mr Young has undertaken to make the Index. The Reports contain a mass of useful information—to be found in no existing publication—of the deepest interest to all who are concerned in the valuable River and Salmon Fisheries of Scotland. They embrace all the Salmon Rivers and Waters of Scotland, both in the Mainland and in the Islands, the whole of which were carefully inspected by Mr Young during the ten years he held the office of Inspector of Salmon Fisheries. It is believed that all the improvements of which the Scottish Salmon Fisheries are sus-

ceptible, are pointed out and recommended in the course of these Reports. That only some of these have been carried out is not the fault of the Fishery Board or of the Inspector, who have power only to recommend, but not to carry out improvements. The chief difficulty in the way has been the very limited and somewhat indefinite statutory powers conferred on the Fishery Board.

We have the honour to be,

My Lord,

Your Lordship's most obedient Servants,

THOMAS J. BOYD, *Chairman.*
JOHN GUTHRIE SMITH, *Deputy-Chairman.*
GEORGE H. M. THOMS.
J. R. G. MAITLAND.
J. COSSAR EWART.
JAMES JOHNSTON.
WILLIAM BOYD.
W. ANDERSON SMITH.

# APPENDICES.

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# APPENDICES.

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## APPENDIX E.

### HARBOUR WORKS AND TELEGRAPHIC EXTENSION.

## APPENDIX A.—No. I.

**HERRING FISHERY.—RETURN, by Districts, showing the Number of Barrels of HERRINGS Cured in SCOTLAND, in the Years 1890 and 1891; with the respective increases or decreases in the latter Year.**

| The Twenty-Six Fishery Districts. | Year 1890, Barrels Cured. | Year 1891, Barrels Cured. | Increase in 1891. | Decrease in 1891. |
|---|---|---|---|---|
| Eyemouth, . . . . | 49,096 | 37,883 | ... | 11,213 |
| Leith, . . . . | 1,028 | 1,967 | 939 | ... |
| Anstruther, . . . | 1,560 | 6,567 | 5,007 | ... |
| Montrose, . . . | 43,941 | 32,521 | ... | 11,420 |
| Stonehaven, . . . | 11,291 | 9,684 | ... | 1,607 |
| Aberdeen, . . . | 110,190 | 91,385 | ... | 18,805 |
| Peterhead, . . . | 221,139 | 156,031 | ... | 65,108 |
| Fraserburgh, . . . | 300,788 | 207,662 | ... | 93,126 |
| Banff, . . . . | 31,990 | 20,766 | ... | 11,224 |
| Buckie, . . . . | 34,070½ | 37,520 | 3,449½ | ... |
| Findhorn, . . . | 22,885 | 23,190 | 305 | ... |
| Cromarty, . . . | 3,883 | 1,155 | ... | 2,728 |
| Helmsdale, . . . | 26,515 | 24,839 | ... | 1,676 |
| Lybster, . . . | 11,307 | 6,757 | ... | 4,550 |
| Wick, . . . . | 123,643 | 58,091 | ... | 65,552 |
| Orkney Isles, . . . | 25,186 | 32,670 | 7,484 | ... |
| Shetland Isles, . . | 104,795 | 109,958 | 5,163 | ... |
| Stornoway, . . . | 125,039½ | 192,589 | 67,549½ | ... |
| Loch Broom, . . . | 2,482 | 3,184 | 702 | ... |
| Loch Carron and Skye, . | 40,825 | 47,261 | 6,436 | ... |
| Fort William, . . | 5,176 | 3,784 | ... | 1,392 |
| Campbeltown, . . | 4,770 | 17,362 | 12,592 | ... |
| Inveraray, . . . | 1,060 | 1,794 | 734 | ... |
| Rothesay, . . . | 621 | 962 | 341 | |
| Green[illegible] . . | ... | ... | ... | |
| B[illegible] | 1,322 | [illegible] | ... | [illegible] |
| [illegible]tal | [illegible],304 603 | [illegible] | 110,70[illegible] | [illegible] |

# APPENDIX A.—No. II.

HERRING FISHERY.—RETURN, by Districts, of the Number of Vessels fitted out in SCOTLAND for the HERRING FISHERY in the Year 1891; the Tonnage and Number of Men; the quantity of Netting, Salt, and Barrels Shipped; and the Number of Barrels of White Herrings Cured on Board.

| DISTRICTS. | Vessels Fitted Out. | | | Quantities Shipped. | | | Barrels of Herrings Cured on Board. | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Gutted. | | | | |
| | Number. | Tonnage. | Men. | Square Yards of Netting. | Bushels of Salt. | Number of Barrels. | Gutted and Packed within 24 hours after being caught. | Gutted and Packed; but *not* within 24 hours after being caught. | Ungutted. | Ungutted in Bulk. | Total. |
| Loch Broom, . . | 16 | 293 | 88 | 140,000 | 3,910 | 2,890 | 2,890 | ... | ... | ... | 2,890 |
| Loch Carron and Skye, . | 32 | 1,044½ | 112 | 37,000 | 46,313 | 18,877 | 6,420 | 30 | 2,566 | 3,428 | 12,444 |
| Fort-William, . . | 7 | 169 | 26 | 17,000 | 3,310 | 1,317 | 1,279 | ... | ... | ... | 1,279 |
| Campbeltown, . . | 1 | 31 | 5 | ... | 850 | 300 | 2,705 | ... | 3,332 | ... | 6,037 |
| Rothesay, . . . | 4 | 61 | 12 | ... | 1,933 | 967 | 505 | ... | ... | ... | 505 |
| Greenock, . . . | 2 | 66 | 8 | ... | 1,100 | 440 | 19,599 | ... | 2,859 | ... | 22,458 |
| Totals, . . | 62 | 1,664½ | 251 | 194,000 | 57,416 | 24,791 | 33,398 | 30 | 8,757 | 3,428 | 45,613 |

*Note.*—The above 62 Vessels made 71 Voyages.

APPENDIX A.—No. III.

**HERRING FISHERY.—RETURN, by Districts, of the Total Number of Barrels of WHITE HERRINGS Cured or Salted in SCOTLAND, on Board Vessels and on Shore, in the Year 1891; distinguishing the Herrings Cured Gutted from those Cured Ungutted; showing also the quantities of Herrings cured as Kippers, Bloaters, or Red Herrings, or Preserved in Tins.**

| DISTRICTS. | Barrels of Herrings Cured on Shore. | | | | | | | | Barrels of Herrings Cured on Board Vessels. | Total Barrels of Herrings Cured on Board Vessels and on Shore. |
|---|---|---|---|---|---|---|---|---|---|---|
| | Gutted. | | Ungutted. | | | | | Total. | | |
| | Gutted and Packed within 24 hours after being caught. | Gutted and Packed but *not* within 24 hours after being caught. | Cured. | Cured in Bulk. | Kippered. | Bloaters or Red Herrings. | Preserved in Tins. | | | |
| Eyemouth, | 23,268 | 2,726 | 30 | ... | 10,501 | 1,358 | ... | 37,883 | ... | 37,883 |
| Leith, | 801 | ... | ... | ... | 1,059 | 107 | ... | 1,967 | ... | 1,967 |
| Anstruther, | 2,717 | 18 | 3,027 | ... | 47 | 758 | ... | 6,567 | ... | 6,567 |
| Montrose, | 31,987 | 107 | 110 | ... | 5 | 312 | ... | 32,521 | ... | 32,521 |
| Stonehaven, | 9,069 | 108 | 24 | ... | 483 | ... | ... | 9,684 | ... | 9,684 |
| Aberdeen, | 72,804 | 3,782 | 1,374 | ... | 5,041 | 307 | 8,077 | 91,385 | ... | 91,385 |
| Peterhead, | 144,359 | 381 | 745 | ... | 9,557 | 70 | 919 | 156,031 | ... | 156,031 |
| Fraserburgh, | 198,891 | 869 | 255 | ... | 4,752 | 104 | 2,791 | 207,662 | ... | 207,662 |
| Banff, | 20,122 | ... | ... | 40 | 604 | ... | ... | 20,766 | ... | 20,766 |
| Buckie, | 35,083 | 224 | ... | ... | 2,159 | 54 | ... | 37,520 | ... | 37,520 |
| Findhorn, | 22,769 | ... | 87 | 20 | ... | 314 | ... | 23,190 | ... | 23,190 |
| Cromarty, | 1,155 | ... | ... | ... | ... | ... | ... | 1,155 | ... | 1,155 |
| Helmsdale, | 23,974 | 732 | 97 | ... | ... | 36 | ... | 24,839 | ... | 24,839 |
| Lybster, | 6,409 | 50 | ... | ... | 286 | 12 | ... | 6,757 | ... | 6,757 |
| Wick, | 51,987 | 820 | 742 | ... | 4,542 | ... | ... | 58,091 | ... | 58,091 |
| Orkney | 27,806 | 4,746 | 118 | ... | ... | ... | ... | 32,670 | ... | 32,670 |
| Shetland, | 109,259 | 196 | 20 | ... | 483 | ... | ... | 109,958 | ... | 109,958 |
| Stornoway, | 118,919 | 24,467 | 7,201 | 150 | 35,769 | 30 | 150 | 186,686 | 5,903 | 192,589 |
| Loch Broom, | 2,993 | ... | ... | ... | ... | ... | ... | 2,993 | 191 | 3,184 |
| Loch Carron and Skye, | 7,497 | 390 | 809 | 50 | ... | ... | ... | 8,746 | 38,515 | 47,261 |
| Fort William, | 2,634 | ... | 1,100 | ... | ... | ... | ... | 3,734 | 50 | 3,784 |
| Campbeltown, | 15,398 | 50 | 238 | ... | 614 | 139 | ... | 16,439 | 923 | 17,362 |
| Inveraray, | 1,731 | ... | ... | ... | 32 | ... | ... | 1,763 | 31 | 1,794 |
| Rothesay, | 517 | ... | ... | ... | 400 | 45 | ... | 962 | ... | 962 |
| Ballantrae, | ... | ... | ... | ... | 490 | ... | ... | 490 | ... | 490 |
| Totals, | 932,149 | 39,666 | 15,977 | 260 | 76,824 | 3,646 | 11,937 | 1,080,459 | 45,613 | 1,126,072 |

*Note.*—Of the barrels of herrings cured in Eyemouth District, the English stations in Northumberland contributed 25,059 barrels.

## APPENDIX A.—No. IV.

HERRING FISHERY.—RETURN, by Districts, of the Total Number of Barrels of Cured WHITE HERRINGS Branded in SCOTLAND, in the Year 1891; distinguishing the number of Barrels Branded Crown Large Full, Full, Maties Full, Spent, and Mixed, and showing the amount of Brand Fees Collected.

| DISTRICTS. | Number of Barrels of Herrings Branded. | | | | | | Brand Fees Collected. |
|---|---|---|---|---|---|---|---|
| | La. Full. | Full. | Mat. Full. | Spt. | Mixed. | Total. | £ s. d. |
| Eyemouth, | ... | 730 | 511 | 167 | 141 | 1,549 | 25 16 4 |
| Anstruther, | ... | 54 | 242 | 29 | ... | 325 | 5 8 4 |
| Montrose, | 3½ | 6,843½ | 2,392½ | 3,640 | 1,408 | 14,282½ | 238 0 10 |
| Stonehaven, | ... | 1,983 | 1,841½ | 1,263 | 372 | 5,459½ | 90 19 10 |
| Aberdeen, | 8 | 13,442 | 8,497½ | 7,832 | 1,992 | 31,771½ | 529 10 6 |
| Peterhead, | ... | 26,370 | 11,689 | 13,030½ | 430½ | 51,520 | 858 13 4 |
| Fraserburgh, | 3,389 | 25,865½ | 19,987 | 12,044½ | 7,601 | 68,887 | 1,148 2 4 |
| Banff, | 15 | 2,654 | 2,612 | 1,685 | 379 | 7,345 | 122 8 4 |
| Buckie, | ... | 3,262½ | 3,037½ | 2,086 | 9 | 8,345 | 139 1 8 |
| Findhorn, | 9½ | 4,144 | 3,922 | 813½ | 845 | 9,734 | 162 4 8 |
| Helmsdale, | ... | 6,205½ | 4,391½ | 1,814 | 135 | 12,546 | 209 2 0 |
| Lybster, | ... | 1,568 | 527½ | 446 | 168 | 2,704½ | 45 1 6 |
| Wick, | ... | 8,517 | 3,202 | 3,312½ | 987½ | 16,019 | 266 19 8 |
| Orkney, | ... | 2,073 | 758 | 1,717 | 2,111 | 6,659 | 110 19 8 |
| Shetland, | 1,247 | 9,579½ | 870½ | 5,153½ | 542½ | 17,393 | 289 17 8 |
| Stornoway, | ... | 1,778 | ... | ... | ... | 1,778 | 29 12 8 |
| Totals, | 4,672 | 115,064½ | 64,481½ | 54,983½ | 17,116½ | 256,818 | £4,271 19 4 |

*Note.*—Of the barrels of herrings branded in Eyemouth District, 1,331 were branded at English stations in Northumberland.

## APPENDIX A.—No. V.

HERRING FISHERY.—RETURN, by Districts, of the Total Number of Barrels of Cured WHITE HERRINGS Exported from SCOTLAND in the Year 1891; distinguishing the Export to Ireland, to the Continent, and to places out of Europe, Herrings Crown Branded from Herrings Unbranded, and giving quantity of Herrings Repacked.

| DISTRICTS. | BARRELS OF HERRINGS EXPORTED. | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | To Ireland. | | | | | | | To the Continent. | | | | | | | | To Places out of Europe. | | | | Total Exported. |
| | Branded. | | | | | Un-branded. | Total. | Branded. | | | | | | Un-branded. | Total. | Branded. Full. | Un-branded. | packed. | Total. | |
| | Full. | Maties Full. | Spent. | Mixed. | Total. | | | Large Full. | Full. | Maties Full. | Spent. | Mixed. | Total. | | | | | | | |
| Eyemouth, . | ... | ... | ... | ... | ... | 626 | 626 | ... | 721½ | 510 | 167 | 141 | 1,539½ | 16,250½ | 17,790 | ... | ... | ... | ... | 18,416 |
| Leith, . . | ... | ... | ... | ... | ... | 200 | 200 | 1 | 12,507 | 450 | 733 | 17 | 13,708 | 39,396 | 53,104 | ... | 196 | ... | 196 | 53,500 |
| Anstruther, | ... | ... | ... | ... | ... | ... | ... | ... | 54 | 242 | 29 | ... | 325 | 848½ | 1,173½ | ... | ... | ... | ... | 1,173½ |
| Montrose, . | ... | ... | ... | ... | ... | ... | ... | 3½ | 6,823½ | 2,302½ | 3,630 | 1,399 | 14,158½ | 11,785 | 25,943½ | 200 | ... | ... | 200 | 26,143½ |
| Stonehaven, . | ... | ... | ... | ... | ... | ... | ... | ... | ... | 1,635½ | 573 | 324 | 2,532½ | 1,181 | 3,713½ | ... | ... | ... | ... | 3,713½ |
| Aberdeen, . | ... | ... | ... | ... | ... | ... | ... | 6 | 7,999½ | 7,808½ | 7,685 | 1,699 | 25,198 | 33,018 | 58,216 | ... | 991 | ... | 991 | 59,207 |
| Peterhead, . | ... | ... | ... | ... | ... | ... | ... | ... | 21,476 | 11,511 | 12,694½ | 529 | 46,210½ | 72,731½ | 118,942 | ... | ... | ... | ... | 118,942 |
| Fraserburgh, | ... | ... | ... | ... | ... | ... | ... | 2,079 | 27,041 | 21,743½ | 12,517½ | 7,851½ | 71,232½ | 93,827½ | 165,060 | ... | ... | ... | ... | 165,060 |
| Banff, . . | ... | ... | ... | ... | ... | ... | ... | 15 | 2,498½ | 2,578½ | 1,666½ | 379 | 7,137½ | 8,106½ | 15,244 | ... | ... | ... | ... | 15,244 |
| Buckie, . | ... | ... | ... | ... | ... | ... | ... | ... | 3,161½ | 2,730½ | 2,004 | 9 | 7,905 | 19,102½ | 27,007½ | ... | ... | ... | ... | 27,007½ |
| Findhorn, . | ... | ... | ... | ... | ... | ... | ... | 9½ | 3,950 | 4,126½ | 795½ | 839 | 9,720½ | 6,855½ | 16,576 | ... | ... | ... | ... | 16,576 |
| Helmsdale, . | ... | ... | ... | ... | ... | ... | ... | ... | 5,904½ | 4,225½ | 1,790 | 119 | 12,039 | 7,425 | 19,464 | ... | ... | ... | ... | 19,464 |
| Lybster, . | ... | ... | ... | ... | ... | ... | ... | ... | 1,327½ | 613 | 358 | 53 | 2,351½ | 2,818½ | 5,170 | ... | ... | ... | ... | 5,170 |
| Wick, . . | ... | ... | ... | ... | ... | 200 | 200 | ... | 8,925 | 2,695 | 3,224½ | 1,176 | 16,020½ | 25,833 | 41,853½ | ... | ... | ... | ... | 42,053½ |
| Orkney, . | ... | ... | ... | ... | ... | 1,026 | 1,026 | ... | 1,882 | 834 | 1,667 | 2,006 | 6,389 | 21,082 | 27,471 | ... | ... | ... | ... | 28,497 |
| Shetland, . | ... | ... | ... | ... | ... | ... | ... | 1,246 | 8,743 | 808 | 5096½ | 415½ | 16,309 | 70,911½ | 87,220½ | ... | ... | ... | ... | 87,220½ |
| Stornoway, . | ... | ... | ... | ... | ... | 2,564 | 2,564 | ... | 878 | ... | ... | ... | 878 | 108,311½ | 109,189½ | ... | ... | ... | ... | 111,753½ |
| Loch Carron and Skye . | ... | ... | ... | ... | ... | 232 | 232 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 232 |
| Fort-William, | ... | ... | ... | ... | ... | 1,100 | 1,100 | ... | ... | ... | ... | ... | ... | 943½ | 943½ | ... | ... | ... | ... | 2,043½ |
| Campbeltown, | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 338 | 338 | ... | ... | ... | ... | 338 |
| Greenock, . | ... | ... | ... | ... | ... | 30,509 | 30,509 | ... | ... | ... | ... | ... | ... | 1,925 | 1,925 | ... | 17,550½ | 976¼ | 18,526¾ | 50,960¾ |
| Totals, . | ... | ... | ... | ... | ... | 36,457 | 36,457 | 3,360 | 113,892½ | 64,814 | 54,631 | 16,957 | 253,654½ | 542,690½ | 796,345 | 200 | 18,737½ | 976¼ | 19,913¾ | 852,715¾ |

*Note.*—Of the barrels of cured herrings exported from Eyemouth District, 12,342 were exported from English stations on the Northumberland coast.

SUPPLEMENTARY RETURN, showing the Ports or Places to which the Herrings Exported to the Continent were Shipped.

| DISTRICTS. | BARRELS OF HERRINGS EXPORTED. | | | | | | | | | | | | | | | To other other Places on the Continent. | Total Exported to the Continent. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | To Russia. | | | | | To Germany. | | | | | | | To Holland. | | | | |
| | Helsingfors. | St Petersburg. | Revel. | Riga. | Liban. | Port Baltic. | Memel. | Königsberg. | Danzig. | Stettin. | Hamburg. | Bremen. | Rotterdam. | Amsterdam. | Antwerp. | | |
| Eyemouth, | ... | ... | ... | ... | ... | ... | ... | 658 | 800 | 8,803 | 7,529 | ... | ... | ... | ... | ... | 17,790 |
| Leith, | ... | 668¼ | ... | 20 | ... | ... | ... | 2,032 | 104½ | 10,158½ | 38,647½ | 22½ | 1,401 | 21 | 11 | 18 | 53,104 |
| Anstruther, | ... | ... | ... | ... | ... | ... | ... | ... | ... | 1,178½ | ... | ... | ... | ... | ... | ... | 1,178½ |
| Montrose, | ... | ... | ... | ... | ... | ... | ... | 6,094½ | 7,146½ | 12,702½ | ... | ... | ... | ... | ... | ... | 25,943½ |
| Stonehaven, | ... | ... | ... | ... | 2,540 | ... | 1,178½ | ... | ... | ... | ... | ... | ... | ... | ... | ... | 3,718½ |
| Aberdeen, | 46 | ... | 853 | ... | 3,824½ | ... | 2,844 | 10,077 | 16,041 | 19,832 | 5,196½ | ... | ... | ... | ... | ... | 58,216 |
| Peterhead, | ... | ... | 960 | 2,528½ | 20,577 | ... | 1,655 | 27,451½ | 7,562½ | 32,183 | 26,694½ | ... | ... | ... | ... | ... | 118,942 |
| Fraserburgh, | 4,310 | ... | 5,257 | 4,220½ | 16,503 | ... | 2,700 | 38,077½ | 11,229 | 55,998½ | 26,764½ | ... | ... | ... | ... | ... | 165,060 |
| Banff, | ... | ... | ... | ... | ... | ... | ... | 1,650 | 5,003 | 8,611 | ... | ... | ... | ... | ... | ... | 15,244 |
| Buckie, | ... | ... | ... | ... | ... | ... | ... | 6,226½ | 6,582½ | 13,055½ | 1,143 | ... | ... | ... | ... | ... | 27,007½ |
| Findhorn, | ... | ... | ... | ... | 2,049 | ... | ... | 3,350½ | ... | 11,176½ | ... | ... | ... | ... | ... | ... | 16,576 |
| Helmsdale, | ... | ... | ... | ... | ... | ... | ... | 3,787½ | 1,442 | 12,718 | 15,66½ | ... | ... | ... | ... | ... | 19,464 |
| Lybster, | ... | ... | ... | ... | ... | ... | ... | ... | 2,044 | 2,481 | 645 | ... | ... | ... | ... | ... | 5,170 |
| Wick, | ... | ... | ... | ... | ... | ... | ... | 827½ | 10,651½ | 26,909 | 3,465½ | ... | ... | ... | ... | ... | 41,853½ |
| Orkney, | ... | 100 | ... | ... | ... | ... | ... | 3,587 | 8,301 | 13,557½ | 1,925½ | ... | ... | ... | ... | ... | 27,471 |
| Shetland, | ... | ... | ... | 1,477 | 809½ | ... | ... | 11,259 | 4,924 | 61,396½ | 7,354½ | ... | ... | ... | ... | ... | 87,220½ |
| Stornoway, | ... | 50,292½ | ... | 1,537½ | 7,526 | 1537½ | ... | 11,820 | 9,967 | 22,381½ | 4,627½ | ... | ... | ... | ... | ... | 109,189½ |
| Fort-William, | ... | ... | ... | ... | ... | ... | ... | ... | ... | 943½ | ... | ... | ... | ... | ... | ... | 943½ |
| Campbeltown, | ... | ... | ... | ... | ... | ... | ... | ... | 338 | ... | ... | ... | ... | ... | ... | ... | 338 |
| Greenock, | ... | ... | ... | ... | ... | ... | ... | ... | 1,061 | 864 | ... | ... | ... | ... | ... | ... | 1,925 |
| Totals, | 4,356 | 51,060¾ | 7,070 | 9,783½ | 53,329 | 1,537½ | 7,772½ | 126,828½ | 93,197½ | 314,945 | 125,491½ | 22½ | 1,401 | 21 | 11 | 18 | 796,345 |

## APPENDIX A.—No. VI.

HERRING FISHERY.—ABSTRACT showing the Total Quantity of WHITE HERRINGS Cured, Branded, and Exported, year by year, *in so far as brought under cognizance of Fishery Officers*, from 1st January 1875 to 31st December 1891; distinguishing the Export to Ireland, to the Continent, and to places out of Europe.

| PERIODS. | Total Number of Barrels of Herrings Cured. | | | Total Number of Barrels of Herrings Branded. | Total Number of Barrels of Herrings Exported. | | | |
|---|---|---|---|---|---|---|---|---|
| | Gutted. | Ungutted including Bulk. | Total. | | To Ireland. | To the Continent. | To places out of Europe. | Total. |
| Year ended 31st December 1875, | 834,822½ | 108,157½ | 942,980 | 523,789½ | 33,434 | 624,137½ | 3,399 | 660,970½ |
| Year ended 31st December 1876, | 486,238½ | 111,959 | 598,197½ | 252,979½ | 20,333 | 378,740 | 1,350½ | 400,423½ |
| Year ended 31st December 1877, | 716,871¼ | 130,847½ | 847,718¾ | 397,795 | 16,085½ | 543,908¼ | 1,992 | 561,985¾ |
| Year ended 31st December 1878, | 771,556 | 134,212 | 905,768 | 456,708 | 17,445¾ | 608,969¼ | 2,519 | 628,934 |
| Year ended 31st December 1879, | 655,991 | 185,805 | 841,796 | 342,323 | 8,857½ | 536,380½ | 755½ | 545,993½ |
| Year ended 31st December 1880, | 1,224,198½ | 249,401¾ | 1,473,600¼ | 689,286 | 32,482½ | 976,300½ | 1,028½ | 1,009,811½ |
| Year ended 31st December 1881, | 915,098 | 196,057¼ | 1,111,155¼ | 494,182½ | 33,459¼ | 711,448 | 972½ | 745,879¾ |
| Year ended 31st December 1882, | 980,755½ | 302,218 | 1,282,973½ | 462,612½ | 40,377 | 782,576¼ | 3,029½ | 825,982¾ |
| Year ended 31st December 1883, | 1,033,087 | 236,325½ | 1,269,412½ | 470,995½ | 25,870 | 863,644½ | 1,246 | 890,760½ |
| Year ended 31st December 1884, | 1,452,213 | 244,864¼ | 1,697,077¼ | 653,425 | 35,299½ | 1,148,956½ | 964½ | 1,185,220½ |
| Year ended 31st December 1885, | 1,352,449 | 220,503¼ | 1,572,952¼ | 689,325 | 22,711 | 1,104,705½ | 1,173 | 1,128,589½ |
| Year ended 31st December 1886, | 1,093,363 | 218,860¼ | 1,312,223¼ | 518,994½ | 27,538½ | 908,896½ | 1,934½ | 938,369½ |
| Year ended 31st December 1887, | 1,064,053¾ | 239,370½ | 1,303,424¼ | 489,998½ | 35,982¼ | 826,920¾ | 3,008¼ | 865,911¼ |
| Year ended 31st December 1888, | 907,000 | 211,872¼ | 1,118,872¼ | 383,980½ | 34,038½ | 735,230½ | 4,924 | 774,193 |
| Year ended 31st December 1889, | 1,179,901 | 217,606 | 1,397,507 | 455,285½ | 32,653 | 931,923¾ | 5,599 | 970,175¾ |
| Year ended 31st December 1890, | 1,188,749½ | 115,853½ | 1,304,603 | 376,280 | 29,639½ | 941,254 | 14,777 | 985,670½ |
| Year ended 31st December 1891, | 1,017,428 | 108,644 | 1,126,072 | 256,318 | 36,457 | 796,345 | 19,913¾ | 852,715¾ |

## APPENDIX B.—No. I.

COD AND LING FISHERY.—RETURN, by Districts, of the Total Number and Quantity of COD, LING, and HAKE Cured in SCOTLAND, in the Year 1891; distinguishing the Fish Cured Dried and the Fish Cured in Pickle.

| DISTRICTS. | Total Number and Quantity of Cod, Ling, and Hake Cured. | | |
|---|---|---|---|
| | Number. | Cwts. Dried. | Barrels Pickled. |
| Leith, | 4,836 | 238 | ... |
| Anstruther, | 220,446 | 9,603 | 63 |
| Montrose, | 42,181 | 1,355 | ... |
| Stonehaven, | 7,960 | 267 | ... |
| Aberdeen, | 143,832 | 5,795 | 20 |
| Peterhead, | 80,970 | 3,983 | 148 |
| Fraserburgh, | 115,550 | 4,343 | ... |
| Banff, | 50,900 | 2,028 | 8 |
| Buckie, | 58,282 | 1,856 | 1,721 |
| Findhorn, | 19,192 | 131 | 735 |
| Helmsdale, | 2,228 | 123 | 18 |
| Lybster, | 15,411 | 10 | 657 |
| Wick, | 161,006 | 2,078 | 5,085 |
| Orkney, | 620,093 | 21,271 | 281 |
| Shetland, | 1,793,971 | 59,135 | ... |
| Stornoway, | 575,813 | 22,225 | 150 |
| Loch Broom, | 63,396 | 2,586 | ... |
| Loch Carron and Skye, | 75,093 | 3,034 | ... |
| Fort-William, | 42,245 | 1,736 | ... |
| Campbeltown, | 154,002 | 4,864 | ... |
| Totals, | 4,247,407 | 146,661 | 8,886 |

*Note.*—Of the total number and quantity of cod, ling, and hake cured in the districts of Fraserburgh, Orkney, and Shetland, 48,120 fish, weighing 1,906 cwts., 254,960 fish, weighing 8,714 cwts., and 585,400 fish, weighing 13,523 cwts. respectively, were cured on board vessels, and afterwards dried on shore. The number and tonnage of, and men employed on, the vessels engaged for this purpose in these three districts were as follows, viz.:— Fraserburgh, 8 vessels, 156 tons, and 148 men; Orkney, 25 vessels, 1,480 tons, and 256 men; Shetland, 31 vessels, 1,421 tons, and 336 men; total, 64 vessels, 3,057 tons, and 640 men.

## APPENDIX B.—No. II.

COD AND LING FISHERY.—RETURN, by Districts, of the Total Quantity of COD, LING, and HAKE Cured Dried, and Exported from SCOTLAND, in the Year 1891; distinguishing the Export to Ireland, to the Continent, and to places out of Europe.

| DISTRICTS. | Cwts. of Cod, Ling, and Hake Cured Dried and Exported. | | | |
|---|---|---|---|---|
| | To Ireland. | To the Continent. | To Places out of Europe. | Total. |
| Leith, | 8,626 | 8,376 | 2,162 | 19,164 |
| Aberdeen, | ... | ... | 1,851 | 1,851 |
| Orkney, | 1,200 | ... | ... | 1,200 |
| Shetland, | 11,405 | 12,524 | 1,120 | 25,049 |
| Stornoway, | 3,127 | ... | ... | 3,127 |
| Campbeltown, | 3,666 | ... | ... | 3,666 |
| Greenock, | 23,644 | ... | 371 | 24,015 |
| Totals, | 51,668 | 20,900 | 5,504 | 78,072 |

## APPENDIX B.—No. III.

COD AND LING FISHERY.—ABSTRACT, showing the Total Quantity of COD, LING, and HAKE Cured and Exported year by year, *in so far as brought under cognizance of Fishery Officers*, from 1st January 1875 to 31st December 1891.

| PERIODS. | Total Quantity of Cod, Ling, and Hake Cured. | | Total Quantity of Cod, Ling, and Hake Cured Dried and Exported. | |
|---|---|---|---|---|
| | Cured Dried. | Cured in Pickle. | | |
| | *Cwts.* | *Barrels.* | *Cwts.* | *qrs.* |
| Year ended 31st December 1875, . . . . | 187,788½ | 8,503½ | 81,880 | 2 |
| Year ended 31st December 1876, . . . . | 111,457 | 6,109 | 59,886 | „ |
| Year ended 31st December 1877, . . . . | 187,200⅓ | 8,619½ | 73,368 | 2 |
| Year ended 31st December 1878, . . . . | 183,809¼ | 9,219 | 94,969 | 2 |
| Year ended 31st December 1879, . . . . | 162,365 | 8,737 | 78,868 | 2 |
| Year ended 31st December 1880, . . . . | 155,745¼ | 7,794⅓ | 79,946 | „ |
| Year ended 31st December 1881, . . . . | 115,513½ | 4,075½ | 61,426 | „ |
| Year ended 31st December 1882, . . . . | 121,337 | 7,737 | 56,497 | „ |
| Year ended 31st December 1883, . . . . | 120,335¾ | 7,310 | 56,525 | 2 |
| Year ended 31st December 1884, . . . . | 124,509⅓ | 5,907½ | 56,716 | 1 |
| Year ended 31st December 1885, . . . . | 125,352½ | 7,100 | 47,241 | „ |
| Year ended 31st December 1886, . . . . | 121,078 | 6,700 | 56,372 | „ |
| Year ended 31st December 1887, . . . . | 122,832 | 7,538 | 87,549 | „ |
| Year ended 31st December 1888, . . . . | 137,216 | 7,052 | 88,100 | „ |
| Year ended 31st December 1889, . . . . | 145,661 | 6,920 | 108,698 | „ |
| Year ended 31st December 1890, . . . . | 145,266½ | 6,186 | 98,775 | „ |
| Year ended 31st December 1891, . . . . | 146,661 | 8,886 | 78,072 | „ |

Fishery Board for Scotland,
Edinburgh, 31st Dec. 1891.

## APPENDIX C.—No. II.

**FISH LANDED BY BEAM TRAWL VESSELS.**—STATEMENT, by Districts, of the Total Quantity and Value of the different kinds of White Fish taken by Beam Trawl Vessels, and landed in SCOTLAND, in the Year 1891.

| DISTRICTS. | Cod. | | Ling. | | Saithe (Coal Fish). | | Haddock. | | Whiting. | | Turbot | | Halibut. | | Sole (Lemon Sole). | | Flounder, Plaice, Brill. | | Eel. | | Skate. | | Other kinds of White Fish. | | Total Value. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cwts. | Value. | Cwts. | Value. | Cwts. | Value. | Cwts. | Value. | Cwts. | Value. | Cwts. | Value. | Cwts. | Value. | Cwts. | Value. | Cwts. | Value. | Cwts. | Value. | Cwts. | Value. | Cwts. | Value. | |
| | | £ | | £ | | £ | | £ | | £ | | £ | | £ | | £ | | £ | | £ | | £ | | £ | £ |
| Leith, . . | 17,710 | 9,172 | 588 | 382 | 349 | 117 | 42,953 | 22,400 | 6,227 | 2,423 | 843¾ | 2,601 | 9 | 25 | 2,810 | 4,424 | 7,437 | 6,870 | 38½ | 18 | 3,663 | 754 | 18,323 | 3,191 | 52,377 |
| Montrose, . | 1,859 | 743 | 97 | 44 | 66 | 15 | 9,811 | 4,949 | 602 | 184 | 197 | 767 | 10¾ | 18 | 978½ | 1,190 | 3,655 | 3,264 | 3 | 3 | 444 | 109 | 2,765 | 843 | 12,129 |
| Aberdeen, . | 18,622 | 9,609 | 988 | 645 | 1,359 | 815 | *101834 | 66,068 | 823 | 401 | 3,024 | 12,410 | 14 | 29 | 13592½ | 24,091 | 35730½ | 38,184 | 31 | 24 | 3,733 | 548 | 24,237 | 3,438 | 156,262 |
| Fraserburgh, | 338 | 208 | 77 | 64 | 17 | 4 | 2,289 | 1,397 | 44 | 18 | 7 | 16 | ... | ... | 27 | 41 | 238 | 239 | 7 | 4 | 32 | 11 | 85 | 20 | 2,022 |
| Findhorn, . | 32 | 12 | ... | ... | ... | ... | 54 | 26 | 5 | 2 | ... | ... | ... | ... | 10 | 9 | 16 | 12 | ... | ... | ... | ... | 4 | 1 | 62 |
| Wick, . . | 28 | 13 | ... | ... | ... | ... | 118 | 46 | 1 | ... | 1 | 2 | ½ | 2 | 12½ | 17 | 39 | 31 | ... | ... | | ... | 10 | 4 | 115 |
| Rothesay, . | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 3 | 5 | 98 | 98 | ... | ... | ... | ... | ... | ... | 98 |
| Greenock, . | 24 | 25 | ... | ... | ... | ... | 42 | 46 | ... | ... | ... | ... | ... | ... | ... | ... | 1,560 | 1,607 | ... | ... | 13 | 4 | ... | ... | 1,682 |
| Ballantrae, . | 27 | 16 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 2,352 | 1,952 | ... | ... | ... | ... | 14 | 5 | 1,973 |
| Totals, . | 33,640 | 19,798 | 1,750 | 1,135 | 1,791 | 951 | 157101 | 94,932 | 7,702 | 3,028 | 4,072¾ | 15,796 | 34½ | 74 | 17433½ | 29,777 | 51120½ | 52,252 | 79½ | 49 | 7,885 | 1,426 | 40,438 | 7,502 | 226,720 |

* This quantity consists largely of gutted Haddocks, with liver, gut, and roe extracted. In August, large quantities of these fish are taken full of herring spawn. The difference between their weight as taken and after being gutted is computed at about one-tenth, which would make total quantity landed about 112,033 cwts. The price per cwt. of the fish, as taken, would therefore be about 11s. 8d. per cwt. Trawled fish being generally of a uniformly larger size than those taken by line, realize higher prices than the latter.

icts, of the

| Whiting. Cwts. | Whiting. Value. | ers. Value. | Crabs. Hundreds. | Crabs. Value. | Other kinds of Shell Fish. Cwts. | Other kinds of Shell Fish. Value. | Total Value of Shell Fish. | Gross Total Value. |
|---|---|---|---|---|---|---|---|---|
| | £ | £ | | £ | | £ | £ | £ |
| 412 | 2,041 | 234 | 2,746·00 | 1,548 | 1,448 | 218 | 2,000 | 39,884 |
| 769 | 4,919 | 248 | 7,630·50 | 4,926 | 2,957 | 627 | 11,199 | 123,082 |
| 821 | 1,250 | 783 | 8,155·25 | 3,843 | 997 | 108 | 8,406 | 50,507 |
| 336 | 1,718 | 373 | 2,717·50 | 1,281 | 2,589 | 413 | 5,625 | 90,746 |
| 641 | 1,673 | 89 | 1,473·50 | 870 | 498 | 79 | 1,038 | 27,683 |
| 817 | 7,471 | 25 | 174·25 | 136 | ... | ... | 161 | 299,523 |
| 917 | 1,049 | 30 | 41·00 | 16 | 182 | 61 | 434 | 167,409 |
| 711 | 425 | 315 | 1,184·00 | 453 | 428 | 71 | 839 | 202,737 |
| 992 | 2,040 | 117 | 1,036·00 | 663 | ... | ... | 780 | 61,334 |
| 946 | 206 | 66 | 2,763·50 | 147 | 223 | 22 | 285 | 67,793 |
| 486 | 1,491 | 33 | 184·00 | 99 | 122 | 29 | 792 | 45,077 |
| 200 | 63 | 19 | 236·50 | 145 | 4,317 | 603 | 1,376 | 7,233 |
| 200 | 65 | 383 | 78·50 | 87 | 1,229½ | 142 | 1,223 | 19,589 |
| ... | ... | 94 | 34·00 | 14 | 323 | 52 | 160 | 7,681 |
| 915 | 197 | 2,882 | 1,298·50 | 561 | 4,021 | 660 | 4,121 | 87,608 |
| 163 | 24,608 | 5,691 | 29,753·00 | 14,789 | 19,334½ | 3,085 | 38,389 | 1,297,886 |
| ... | ... | 5,170 | 174·00 | 92 | 3,854 | 657 | 5,956 | 43,414 |
| ... | ... | ... | ... | ... | 2,317 | 223 | 311 | 101,338 |
| ... | ... | 5,170 | 174·00 | 92 | 6,171 | 880 | 6,267 | 144,752 |
| 279 | 66 | 10,475 | 305·00 | 130 | 4,936 | 711 | 11,426 | 176,975 |
| ,044 | 224 | 3,086 | 163·00 | 36 | 1,795 | 318 | 3,668 | 12,214 |
| 87 | 29 | 2,598 | 111·00 | 43 | 4,817 | 693 | 3,334 | 22,348 |
| 111 | 135 | 1,651 | ... | ... | 4,144 | 648 | 2,299 | 11,938 |
| ,232 | 1,152 | 1,445 | 5·00 | 3 | 4,343 | 1,436 | 2,912 | 51,563 |
| 205 | 125 | 680 | 5·00 | 5 | 1,689 | 385 | 1,779 | 58,265 |
| ,401 | 1,123 | 162 | ... | ... | 1,634 | 464 | 882 | 16,241 |
| 764 | 801 | 366 | ... | ... | 251 | 132 | 2,542 | 13,254 |
| ,790 | 1,226 | 344 | 408·00 | 197 | 1,616 | 1,203 | 2,667 | 33,223 |
| ,913 | 4,881 | 20,807 | 997·00 | 414 | 25,225 | 5,990 | 31,509 | 396,021 |
| ,163 | 24,608 | 5,691 | 29,753·00 | 14,789 | 19,334½ | 3,085 | 38,389 | 1,297,886 |
| ... | ... | 5,170 | 174·00 | 92 | 6,171 | 880 | 6,267 | 144,752 |
| ,913 | 4,881 | 20,807 | 997·00 | 414 | 25,225 | 5,990 | 31,509 | 396,021 |
| ,076 | 29,489 | 31,668 | 30,924·00 | 15,295 | 50,730½ | 9,955 | 76,165 | 1,838,659 |
| ,522 | 30,840 | 28,340 | 28,823·41 | 14,568 | 54,169½ | 9,667 | 68,613 | 1,691,959 |
| ... | ... | 3,328 | 2,100·59 | 727 | ... | 288 | 7,552 | 146,700 |
| ,446 | 1,351 | ... | ... | ... | 3,439 | ... | ... | ... |

ed in crans, i od landed, 88,144 cwts. were cured dried, and 8,886 barrels pickled;
dried; of to

(p. 15A).

## APPENDIX C.—No. III.

FISH USED IN A FRESH STATE.—STATEMENT, by Districts, of the Total Quantity and Value of White and Shell Fish taken in SCOTLAND, and sold for use in a fresh state, or consumed in the localities where taken, in the year 1891.

| Districts. | Total Quantity of White Fish used Fresh. | | | | | | | Total Value of White Fish used Fresh. | Total Value of Shell Fish. | Gross Total Values. |
|---|---|---|---|---|---|---|---|---|---|---|
| | Herrings. | Cod. | Ling. | Torsk. | Saithe. | Other Kinds of Fish. | Total. | | | |
| | Cwts. | Cwts. | Cwts. | Cwts. | Cwts. | Cwts. | Cwts. | £ | £ | £ |
| Eyemouth, | 21,346 | 4,159 | 55 | ... | 462 | 33,153 | 59,175 | 26,462 | 2,000 | 28,462 |
| Leith, | 15,461 | 52,600 | 3,244 | ... | 3,202 | 131,564½ | 206,071½ | 109,953 | 11,199 | 121,152 |
| Anstruther, | 21,884 | 20,008 | 375 | ... | 1,399 | 31,556 | 75,222 | 32,644 | 8,406 | 41,050 |
| Montrose, | 9,533 | 10,319 | 352 | ... | 654 | 112,556 | 133,414 | 61,215 | 5,625 | 66,840 |
| Stonehaven, | 6,579 | 9,098 | 281 | ... | 466 | 36,086 | 52,510 | 20,033 | 1,038 | 21,071 |
| Aberdeen, | 15,497 | 33,132 | 5,033 | 52 | 838 | 260,082½ | 314,634½ | 221,317 | 161 | 221,478 |
| Peterhead, | 10,525 | 23,657 | 4,260 | 283 | 6,152 | 70,683 | 115,560 | 43,972 | 434 | 44,406 |
| Fraserburgh, | 13,051 | 12,501 | 4,525 | 235 | 2,376 | 60,219½ | 92,907½ | 39,582 | 839 | 40,421 |
| Banff, | 9,624 | 10,896 | 516 | 6 | 779 | 70,616 | 92,437 | 39,038 | 780 | 39,818 |
| Buckie, | 13,695 | 10,236 | 3,750 | 65 | 826 | 55,872½ | 84,444½ | 38,165 | 235 | 38,400 |
| Findhorn, | 12,162 | 10,084 | 1,401 | 12 | 397 | 37,112 | 61,168 | 27,744 | 792 | 28,536 |
| Cromarty, | 4,571 | 2,494 | 13 | ... | 20 | 7,142½ | 14,240½ | 5,217 | 1,376 | 6,593 |
| Helmsdale, | 763 | 4,900 | 91 | ... | 199 | 5,339½ | 11,292½ | 4,357 | 1,223 | 5,580 |
| Lybster, | 1,700 | 1,557 | 18 | 30 | 836 | 2,056½ | 6.197½ | 1,658 | 160 | 1,818 |
| Wick, | 44,103 | 22,074 | 10,788 | 68 | 7,953 | 36,940½ | 121,926½ | 34,523 | 4,121 | 38,644 |
| Orkney, | 2,815 | 8,911 | 851 | 30 | 1,589 | 24,462 | 38,658 | 6,940 | 5,956 | 12,896 |
| Shetland, | 3,500 | 3,000 | 1,730 | 300 | 164 | 24,809 | 33,503 | 8,893 | 311 | 9,204 |
| Stornoway, | 112,325 | 7,005 | 9,724 | 1,100 | 6,501 | 38,876 | 175,531 | 37,644 | 11,426 | 49,070 |
| Loch Broom, | 2,588 | 3,524 | 2,055 | ... | 1,409 | 10,283 | 19,859 | 4,769 | 3,668 | 8,437 |
| Loch Carron and Skye, | 37,565 | 715 | 454 | ... | 1,098 | 3,094 | 42,926 | 6,485 | 3,334 | 9,819 |
| Fort-William, | 4,625 | 2,212 | 513 | 2 | 1,737 | 3,615 | 12,704 | 5,564 | 2,299 | 7,863 |
| Campbeltown, | 117,641 | 8,280 | 771 | ... | 1,456 | 5,895 | 134,043 | 39,856 | 2,912 | 42,768 |
| Inveraray, | 176,337 | 938 | 56 | ... | 1,443 | 1,890 | 180,664 | 54,917 | 1,779 | 56,696 |
| Rothesay, | 33,217 | 1,731 | 322 | ... | 1,125 | 4,030 | 40,425 | 14,167 | 882 | 15,049 |
| Greenock, | 8,326 | 915 | 54 | ... | 310 | 4,301 | 13,906 | 10,712 | 2,542 | 13,254 |
| Ballantrae, | 48,494 | 10,741 | 611 | ... | 1,170 | 13,317 | 74,333 | 29,994 | 2,667 | 32,661 |
| Totals, | 747,927 | 275,687 | 51,843 | 2,183 | 44,561 | 1,085,552 | 2,207,753 | 925,821 | 76,165 | 1,001,986 |

## APPENDIX D.—No. I.

FISHERY STATISTICS.—RETURN of the Number of Boats, Decked and Un-decked, *irrespective* of the places to which they belong, employed in the Herring Fishery in SCOTLAND, in the Season of 1891, in a selected Week for each District, with the Number of Fishermen and Boys by whom manned; of Coopers, Gutters, Packers, and Labourers employed at the said Fishery in the Week so selected; and the Total Number of all such Fishermen and other persons so employed.

| Districts where the Boats were employed at the Herring Fishery. | Boats. | Fishermen and Boys. | Coopers. | Gutters and Packers. | Labourers. | Total Persons Employed. |
|---|---|---|---|---|---|---|
| Eyemouth, . . | 209 | 1,232 | 129 | 1,079 | 239 | 2,679 |
| Leith, . . . | 51 | 204 | 45 | 300 | 196 | 745 |
| Anstruther, . . | 123 | 861 | 35 | 120 | 33 | 1,049 |
| Montrose, . . | 150 | 965 | 86 | 703 | 140 | 1,894 |
| Stonehaven, . . | 65 | 455 | 32 | 218 | 28 | 733 |
| Aberdeen, . . | 365 | 2,373 | 174 | 1,850 | 384 | 4,781 |
| Peterhead, . . | 530 | 3,420 | 378 | 2,173 | 211 | 6,182 |
| Fraserburgh, . . | 722 | 4,694 | 472 | 3,167 | 447 | 8,780 |
| Banff, . . . | 134 | 835 | 58 | 392 | 48 | 1,333 |
| Buckie, . . . | 140 | 840 | 78 | 525 | 43 | 1,486 |
| Findhorn, . . | 120 | 790 | 54 | 441 | 48 | 1,333 |
| Cromarty, . . | 21 | 126 | 4 | 42 | 4 | 176 |
| Helmsdale, . | 143 | 862 | 74 | 492 | 34 | 1,462 |
| Lybster, . . . | 77 | 495 | 33 | 244 | 17 | 789 |
| Wick, . . . | 460 | 2,987 | 253 | 1,607 | 197 | 5,044 |
| Orkney, . . . | 258 | 1,548 | 66 | 631 | 53 | 2,298 |
| Shetland, . . . | 514 | 3,081 | 181 | 1,551 | 32 | 4,845 |
| Stornoway, . . | 1,084 | 6,711 | 366 | 3,192 | 411 | 10,680 |
| Loch Broom, . . | 72 | 342 | 7 | 105 | 4 | 458 |
| Loch Carron and Skye, | 310 | 1,080 | 63 | 449 | 30 | 1,622 |
| Fort-William, . . | 74 | 210 | 11 | 91 | 15 | 327 |
| Campbeltown, . . | 375 | 1,380 | 30 | 129 | 118 | 1,657 |
| Inveraray, . . | 300 | 1,030 | 3 | 58 | 39 | 1,130 |
| Rothesay, . . . | 120 | 360 | 5 | 34 | 10 | 409 |
| Greenock, . . | 101 | 290 | 43 | 390 | 92 | 815 |
| Ballantrae, . . | 365 | 1,460 | 63 | 67 | 166 | 1,756 |

## APPENDIX D.—No. II.

FISHERY STATISTICS.—RETURN, by Districts, of the Number and Tonnage of Boats, Decked and Undecked, and Beam Trawl Vessels, employed in the Sea Fisheries of SCOTLAND, in the year 1891; the Number of Fishermen and Boys by whom manned; the Number of Fish-Curers, Coopers, and other Persons employed; with the estimated Value of Boats, Beam Trawl Vessels, Nets, and Lines.

| Districts. | Fishing Boats. First Class, 30 feet keel and upwards. | | Second Class, from 18 to 30 feet keel. | | Third Class, under 18 feet keel. | | Beam Trawl Vessels. | | Total Fishing Boats and Beam Trawl Vessels. | | Fishermen and Boys. | Fish-curers. | Coopers. | Other Persons (*Estimated*). | Total Persons employed. | Value (*Estimated*) of— Boats and Bm. Trawl Vessels. | Nets. | Lines. | Total. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Number.* | *Tons.* | *Number.* | *Tons.* | *Number.* | *Tons.* | *Number.* | *Tons.* | *Number.* | *Tons.* | | | | | | £ | £ | £ | £ |
| Eyemouth, | 199 | 3,460 | 182 | 1,081 | 99 | 198 | ... | ... | 480 | 4,739 | 1,146 | 55 | 130 | 2,263 | 3,594 | 21,375 | 23,211 | 5,898 | 50,484 |
| Leith, | 157 | 3,696 | 320 | 1,767 | 55 | 159 | 18 | 645 | 550 | 6,267 | 1,918 | 20 | 45 | 2,586 | 4,569 | 98,050 | 28,853 | 6,781 | 133,684 |
| Anstruther, | 451 | 8,970 | 193 | 804 | 95 | 190 | 3 | 236 | 742 | 10,200 | 3,185 | 42 | 37 | 1,758 | 5,022 | 64,114 | 73,240 | 11,178 | 148,532 |
| Montrose, | 201 | 3,559 | 229 | 916 | 200 | 400 | 5 | 390 | 635 | 5,265 | 1,306 | 20 | 86 | 2,676 | 4,088 | 48,245 | 21,130 | 9,262 | 78,637 |
| Stonehaven, | 105 | 1,568 | 45 | 190 | 53 | 106 | ... | ... | 203 | 1,864 | 513 | 20 | 32 | 689 | 1,254 | 12,073 | 9,084 | 3,966 | 25,123 |
| Aberdeen, | 111 | 1,776 | 96 | 576 | 43 | 86 | 34 | 4,522 | 284 | 6,960 | 989 | 38 | 174 | 4,107 | 5,308 | 145,087 | 16,935 | 4,422 | 166,444 |
| Peterhead, | 314 | 5,936 | 128 | 601 | 66 | 130 | ... | ... | 508 | 6,667 | 1,969 | 91 | 378 | 3,299 | 5,737 | 55,972 | 38,570 | 1,1265 | 105,807 |
| Fraserburgh, | 266 | 5,320 | 115 | 690 | 275 | 825 | ... | ... | 656 | 6,835 | 1,230 | 83 | 472 | 5,044 | 6,829 | 43,890 | 43,227 | 6,665 | 93,782 |
| Banff, | 218 | 4,360 | 127 | 762 | 113 | 339 | ... | ... | 458 | 5,461 | 1,583 | 23 | 58 | 1,008 | 2,672 | 35,128 | 20,120 | 5,890 | 61,138 |
| Buckie, | 554 | 11,634 | 71 | 355 | 108 | 324 | ... | ... | 733 | 12,313 | 3,619 | 27 | 92 | 3,561 | 7,299 | 98,558 | 88,700 | 17,510 | 204,768 |
| Findhorn, | 260 | 5,052 | 106 | 670 | 18 | 67 | ... | ... | 384 | 5,789 | 2,035 | 24 | 85 | 2,441 | 4,585 | 46,100 | 40,115 | 6,552 | 92,767 |
| Cromarty, | 126 | 1,918 | 122 | 571 | 49 | 113 | ... | ... | 297 | 2,602 | 1,029 | 5 | 11 | 882 | 1,927 | 12,074 | 22,942 | 2,988 | 38,004 |
| Helmsdale, | 100 | 1,596 | 50 | 233 | 45 | 103 | ... | ... | 195 | 1,932 | 653 | 14 | 74 | 562 | 1,303 | 7,747 | 6,964 | 2,070 | 16,781 |
| Lybster, | 96 | 1,868 | 20 | 109 | 32 | 64 | ... | ... | 148 | 2,041 | 634 | 14 | 33 | 354 | 1,035 | 5,210 | 7,895 | 441 | 13,546 |
| Wick, | 319 | 6,200 | 60 | 440 | 390 | 1,170 | ... | ... | 769 | 7,810 | 2,998 | 127 | 278 | 3,047 | 6,450 | 44,027 | 41,350 | 4,407 | 89,784 |
| Orkney, | 171 | 2,724 | 37 | 188 | 446 | 892 | ... | ... | 654 | 3,804 | 2,138 | 34 | 70 | 756 | 2,998 | 17,054 | 10,437 | 1,780 | 29,271 |
| Shetland, | 285 | 4,430 | 123 | 246 | 457 | 457 | ... | ... | 865 | 5,133 | 2,863 | 70 | 277 | 3,003 | 6,213 | 26,576 | 22,668 | 6,849 | 56,093 |
| Stornoway, | 243 | 4,281 | 483 | 3,124 | 782 | 2,346 | ... | ... | 1,508 | 9,751 | 5,626 | 51 | 82 | 3,700 | 9,459 | 42,851 | 29,750 | 10,176 | 82,777 |
| Loch Broom, | 63 | 969 | 71 | 361 | 436 | 1,308 | ... | ... | 570 | 2,638 | 1,914 | 24 | 10 | 842 | 2,790 | 6,651 | 10,350 | 1,659 | 18,660 |
| Loch Carron and Skye, | 22 | 416 | 308 | 1,364 | 540 | 1,085 | ... | ... | 870 | 2,865 | 2,627 | 74 | 63 | 829 | 3,593 | 6,700 | 20,607 | 3,118 | 30,425 |
| Fort-William, | 10 | 204 | 145 | 520 | 245 | 481 | ... | ... | 400 | 1,205 | 975 | 12 | 13 | 376 | 1,376 | 4,813 | 2,675 | 821 | 8,309 |
| Campbeltown, | 33 | 576 | 375 | 1,984 | 219 | 438 | 6 | 108 | 633 | 3,106 | 1,797 | 56 | 39 | 973 | 2,865 | 12,948 | 12,431 | 1,235 | 26,614 |
| Inveraray, | ... | ... | 312 | 1,872 | 121 | 242 | ... | ... | 433 | 2,114 | 1,060 | 14 | 3 | 244 | 1,321 | 14,846 | 12,419 | 816 | 28,081 |
| Rothesay, | 4 | 60 | 129 | 587 | 89 | 178 | 2 | 14 | 224 | 839 | 421 | 13 | 5 | 189 | 628 | 3,785 | 5,681 | 266 | 9,732 |
| Greenock, | 1 | 10 | 95 | 383 | 115 | 176 | 17 | 235 | 228 | 804 | 387 | 32 | 46 | 1,701 | 2,166 | 6,242 | 4,465 | 705 | 11,412 |
| Ballantrae, | 4 | 40 | 204 | 831 | 251 | 282 | 47 | 334 | 506 | 1,487 | 909 | 49 | 63 | 932 | 1,953 | 8,449 | 6,993 | 1,208 | 16,650 |
| Totals, | 4,313 | 80,623 | 4,146 | 21,225 | 5,342 | 12,159 | 132 | 6,484 | 13,933 | 120,491 | 45,524 | 1,032 | 2,656 | 47,822 | 97,034 | 888,565 | 620,812 | 127,928 | 1,637,305 |

## APPENDIX D.—No. III.

FISHERY STATISTICS.—RETURN, by Districts, of the Number and Tonnage of Beam Trawl Vessels and Boats, employed in the Sea Fisheries of SCOTLAND, in the year 1891; the Number of Fishermen and Boys by whom manned; distinguishing Steam Trawlers from Sailing Trawlers; and giving the estimated Value of the Vessels, Nets, and Fishing Material.

| DISTRICTS. | BEAM TRAWL VESSELS AND BOATS. | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Steam Trawlers. | | | | | Sailing Trawlers. | | | | | Total. | | | | |
| | Number. | Tons. | Men. | Value of Vessels. | Value of Nets, &c. | Number. | Tons. | Men. | Value of Vessels. | Value of Nets, &c. | Number. | Tons. | Men. | Value of Vessels. | Value of Nets, &c. |
| | | | | £ | £ | | | | £ | £ | | | | £ | £ |
| Leith, | 18 | 645 | 136 | 52,200 | 1,080 | ... | ... | ... | ... | ... | 18 | 645 | 136 | 52,200 | 1,080 |
| Anstruther, | 3 | 236 | 23 | 9,000 | 690 | ... | ... | ... | ... | ... | 3 | 236 | 23 | 9,000 | 690 |
| Montrose, | 5 | 390 | 36 | 12,100 | 500 | ... | ... | ... | ... | ... | 5 | 390 | 36 | 12,100 | 500 |
| Aberdeen, | 34 | 4,522 | 255 | 131,852 | 6,000 | ... | ... | ... | ... | ... | 34 | 4,522 | 255 | 131,852 | 6,000 |
| Campbeltown, | ... | ... | ... | ... | ... | 6 | 108 | ... | 900 | 100 | 6 | 108 | ... | 900 | 100 |
| Rothesay, | ... | ... | ... | ... | ... | 2 | 14 | 6 | 60 | 26 | 2 | 14 | 6 | 60 | 26 |
| Greenock, | 1 | 136 | 7 | 3,300 | 140 | 16 | 99 | 64 | 411 | 260 | 17 | 235 | 71 | 3,711 | 400 |
| Ballantrae, | ... | ... | ... | ... | ... | 47 | 334 | 99 | 2,290 | 866 | 47 | 334 | 99 | 2,290 | 866 |
| Totals, | 61 | 5,929 | 457 | 208,452 | 8,410 | 71 | 555 | 169 | 3,661 | 1,252 | 132 | 6,484 | 626 | 212,113 | 9,662 |

APPENDIX D.—No IV.

FISHERY STATISTICS.—RETURN, by Districts, of the Tonnage of Shipping, and of the Number of Seamen engaged in the Trade of the Herring and Cod and Ling Fisheries of SCOTLAND, in the year 1891; distinguishing those employed in Importing Stave Wood, Hoops, and Salt; in Carrying Herrings or Cod Fish Coastwise; or Exporting them abroad; and distinguishing British from Foreign Tonnage and Men.

| DISTRICTS. | TONNAGE AND MEN. | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Importing Stave Wood and Hoops. | | | | Importing Salt. | | | | Carrying Herrings or Cod Fish Coastwise. | | | | Exporting Herrings or Cod Fish. | | | | Total. | | | |
| | British. | | Foreign. | | British. | | Foreign. | | British. | | Foreign. | | British. | | Foreign. | | British. | | Foreign. | |
| | Tons. | Men. | Tons. | Men. | Tons. | Men. | Tons. | Men. | Tons. | Men. | Tons. | Men. | Tons. | Men. | Tons. | Men. | Tons. | Men. | Tons. | Men. |
| Eyemouth, | ... | ... | 186 | 12 | 1,263 | 78 | 255 | 11 | 533 | 34 | 75 | 4 | 722 | 43 | 973 | 52 | 2,518 | 155 | 1,489 | 79 |
| Leith, | ... | ... | 400 | 20 | 190 | 9 | ... | ... | 900 | 50 | ... | ... | 9,233 | 658 | ... | ... | 10,323 | 717 | 400 | 20 |
| Anstruther, | 140 | 8 | 319 | 20 | 77 | 5 | 114 | 6 | ... | ... | ... | ... | ... | ... | 125 | 6 | 217 | 13 | 558 | 32 |
| Montrose, | 30 | 4 | 540 | 21 | 1,472 | 81 | ... | ... | ... | ... | ... | ... | 1,252 | 63 | 1,429 | 59 | 2,754 | 148 | 1,969 | 80 |
| Stonehaven, | ... | ... | ... | ... | 273 | 17 | ... | ... | 150 | 12 | ... | ... | 165 | 11 | 242 | 15 | 588 | 40 | 242 | 15 |
| Aberdeen, | 5,141 | 297 | 340 | 19 | 3,010 | 185 | 415 | 14 | 2,220 | 135 | ... | ... | 3,450 | 122 | 1,629 | 79 | 13,821 | 739 | 2,384 | 112 |
| Peterhead, | ... | ... | 1,592 | 86 | 2,803 | 158 | 2,460 | 98 | 710 | 35 | ... | ... | 5,318 | 215 | 6,246 | 284 | 8,831 | 408 | 10,298 | 468 |
| Fraserburgh, | 229 | 13 | 1,641 | 67 | 6,549 | 209 | 1,091 | 36 | 251 | 9 | 199 | 8 | 6,271 | 271 | 9,570 | 463 | 13,300 | 502 | 12,501 | 574 |
| Banff, | ... | ... | ... | ... | 1,528 | 86 | ... | ... | 100 | 20 | ... | ... | 1,217 | 75 | 87 | 5 | 2,845 | 181 | 87 | 5 |
| Buckie, | 70 | 5 | 87 | 5 | 881 | 43 | ... | ... | ... | ... | ... | ... | 1,281 | 69 | 977 | 54 | 2,232 | 117 | 1,064 | 59 |
| Findhorn, | ... | ... | ... | ... | 712 | 38 | ... | ... | 60 | 4 | ... | ... | 1,269 | 68 | 475 | 27 | 2,041 | 110 | 475 | 27 |
| Cromarty, | ... | ... | ... | ... | 150 | 7 | ... | ... | 300 | 28 | ... | ... | ... | ... | ... | ... | 450 | 35 | ... | ... |
| Helmsdale, | 99 | 5 | 317 | 17 | 777 | 44 | 80 | 5 | 120 | 6 | ... | ... | 1,115 | 65 | 715 | 38 | 2,111 | 120 | 1,112 | 60 |
| Lybster, | 120 | 7 | ... | ... | 550 | 20 | ... | ... | 75 | 12 | ... | ... | 399 | 19 | 131 | 7 | 1,144 | 58 | 131 | 7 |
| Wick, | 684 | 43 | 3,082 | 171 | 3,018 | 161 | 733 | 31 | 1,517 | 106 | ... | ... | 2,887 | 136 | 1,624 | 85 | 8,106 | 446 | 5,439 | 287 |
| Orkney, | ... | ... | 60 | 5 | 2,078 | 123 | ... | ... | 2,173 | 182 | ... | ... | 1,650 | 101 | 1,441 | 78 | 5,901 | 406 | 1,501 | 83 |
| Shetland, | ... | ... | 350 | 18 | 2,213 | 132 | 436 | 21 | 5,950 | 298 | ... | ... | 3,765 | 181 | 5,876 | 289 | 11,928 | 611 | 6,662 | 328 |
| Stornoway, | 3,880 | 313 | 2,040 | 101 | 5,889 | 274 | 380 | 17 | 17,650 | 1,272 | ... | ... | 7,421 | 389 | 3,576 | 185 | 34,840 | 2,248 | 5,996 | 303 |
| Loch Broom, | ... | ... | ... | ... | 475 | 63 | ... | ... | 895 | 161 | ... | ... | ... | ... | ... | ... | 1,370 | 224 | ... | ... |
| Loch Carron and Skye, | ... | ... | ... | ... | 1,795 | 109 | ... | ... | 2,171 | 176 | ... | ... | 86 | 7 | ... | ... | 4,052 | 292 | ... | ... |
| Fort-William, | ... | ... | ... | ... | 532 | 45 | ... | ... | 154 | 16 | ... | ... | 577 | 35 | ... | ... | 1,263 | 96 | ... | ... |
| Campbeltown, | ... | ... | ... | ... | 185 | 14 | ... | ... | 7,166 | 406 | ... | ... | 565 | 73 | ... | ... | 7,916 | 493 | ... | ... |
| Inveraray, | ... | ... | ... | ... | 146 | 9 | ... | ... | 862 | 75 | ... | ... | ... | ... | ... | ... | 1,008 | 84 | ... | ... |
| Rothesay, | ... | ... | ... | ... | ... | ... | ... | ... | 334 | 38 | ... | ... | ... | ... | ... | ... | 334 | 38 | ... | ... |
| Greenock, | 60 | 4 | ... | ... | 1,100 | 52 | ... | ... | 907 | 50 | ... | ... | 8,206 | 408 | 126 | 7 | 10,273 | 514 | 126 | 7 |
| Ballantrae, | ... | ... | ... | ... | 128 | 11 | ... | ... | 215 | 6 | ... | ... | ... | ... | ... | ... | 343 | 17 | ... | ... |
| Totals, | 10,453 | 699 | 10,954 | 562 | 37,794 | 1,973 | 5,964 | 239 | 45,413 | 3,131 | 274 | 12 | 56,849 | 3,009 | 35,242 | 1,733 | 150,509 | 8,812 | 52,434 | 2,546 |

## APPENDIX D.—No. V.

FISHERY STATISTICS.—ABSTRACT RETURN, showing the Tonnage of Vessels and Number of Men; the Tonnage of Boats and Number of Fishermen and Boys; and the Number of other Persons employed in the Sea Fisheries of SCOTLAND, in the Year 1891.

| ABSTRACT. | Tonnage of Vessels and Number of Men. | | | | Tonnage of Boats and Number of Fishermen and Boys. | | Number of other Persons. | Total Tonnage and Persons employed. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | British. | | Foreign. | | | | | British. | | Foreign. | |
| | Tons. | Men. | Tons. | Men. | Tons. | Fishermen and Boys. | | Tons. | Men. | Tons. | Men. |
| Total of Herring Fishery Account, Appendix A—Table II., . . | 1,664½ | 251 | ... | ... | ... | ... | ... | 1,664½ | 251 | ... | ... |
| Total of Cod and Ling Fishery Account, Appendix B—Table I., | 3,057 | 640 | ... | ... | ... | ... | ... | 3,057 | 640 | ... | ... |
| Total of Fishery Statistics Account, Appendix D—Table II., . . | ... | ... | ... | ... | 120,491 | 45,524 | 51,510 | 120,491 | 97,034 | ... | ... |
| Total of Fishery Statistics Account, Appendix D—Table IV., . . | 150,509 | 8,812 | 52,434 | 2,546 | ... | ... | ... | 150,509 | 8,812 | 52,434 | 2,546 |
| Totals, | 155,230½ | 9,703 | 52,434 | 2,546 | 120,491 | 45,524 | 51,510 | 275,721½ | 106,737 | 52,434 | 2,546 |

APPENDIX D.—No. VI.

FISHERY STATISTICS.—RETURN, by Districts, of the Number of Lives Lost in connection with the Sea Fisheries of SCOTLAND, and the manner in which the Casualties happened; the Number of Boats totally wrecked, and Value thereof; the Number of Boats damaged, and Amount of Damage; and the Loss on Nets and other Fishing Material lost or damaged, in the Year 1891.

| DISTRICTS. | Lives Lost. | | | | | | | Boats Totally Wrecked, and Value thereof. | | Boats Damaged, and Amount of Damage. | | Loss on Boats Totally Wrecked or Damaged. | Loss on Nets and other Fishing Material, Lost or Damaged. | Total Loss on Boats, Nets, &c., Lost or Damaged. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Through foundering at Sea. | In taking Harbour. | In collisions. | Washed Overboard | Falling Overboard. | Knocked Overboard or Killed by Sail, &c. | Total. | Number. | Value. | Number. | Amount of Damage. | | | |
| Eyemouth, | 1 | 2 | ... | 1 | ... | ... | 4 | 5 | £ 78 | 9 | £ 46 | £ 124 | £2,112 | £2,236 |
| Leith, | ... | 7 | 2 | ... | ... | ... | 9 | 7 | 4,940 | 14 | 595 | 5,535 | 2,620 | 8,155 |
| Anstruther, | ... | ... | ... | ... | 1 | 1 | 2 | 5 | 40 | 9 | 206 | 246 | 1,791 | 2,037 |
| Montrose, | 4 | 5 | ... | ... | ... | ... | 9 | 3 | 325 | 13 | 62 | 387 | 1,840 | 2,227 |
| Stonehaven, | ... | ... | ... | ... | ... | ... | ... | ... | ... | 1 | 8 | 8 | 449 | 457 |
| Aberdeen, | 2 | ... | ... | ... | ... | 1 | 3 | 1 | 5 | 12 | 575 | 580 | 9,846 | 10,426 |
| Peterhead, | ... | ... | ... | ... | ... | ... | ... | ... | ... | 3 | 30 | 30 | 2,925 | 2,955 |
| Fraserburgh, | ... | ... | ... | ... | ... | 2 | 2 | 1 | 120 | 43 | 255 | 375 | 7,848 | 8,223 |
| Banff, | ... | ... | ... | ... | ... | ... | ... | 1 | 85 | 9 | 110 | 195 | 1,390 | 1,585 |
| Buckie, | 2 | ... | ... | 3 | ... | 1 | 6 | 2 | 80 | 1 | 1 | 81 | 1,483 | 1,564 |
| Findhorn, | ... | ... | ... | ... | 1 | 1 | 2 | 1 | 240 | 4 | 37 | 277 | 982 | 1,259 |
| Cromarty, | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 835 | 835 |
| Helmsdale, | ... | ... | ... | ... | 1 | ... | 1 | 1 | 20 | 8 | 89 | 109 | 445 | 554 |
| Lybster, | ... | ... | ... | ... | ... | 1 | 1 | ... | ... | 2 | 10 | 10 | 253 | 263 |
| Wick, | ... | ... | ... | ... | ... | ... | ... | 1 | 100 | 9 | 77 | 177 | 1,922 | 2,099 |
| Orkney, | ... | ... | ... | ... | ... | ... | ... | ... | ... | 1 | 4 | 4 | 200 | 204 |
| Shetland, | 11 | 2 | ... | ... | 1 | ... | 14 | 3 | 84 | 1 | 35 | 119 | 250 | 369 |
| Stornoway, | 8 | ... | ... | 1 | 3 | 2 | 14 | 7 | 850 | 36 | 645 | 1,495 | 1,310 | 2,805 |
| Loch Broom, | ... | ... | ... | ... | ... | ... | ... | 3 | 180 | 7 | 30 | 210 | 270 | 480 |
| Loch Carron and Skye, | ... | ... | ... | ... | ... | 1 | 1 | 1 | 8 | 10 | 44 | 52 | 1,030 | 1,082 |
| Fort-William, | ... | ... | ... | ... | ... | ... | ... | 2 | 13 | 4 | 12 | 25 | 230 | 255 |
| Campbeltown, | ... | 1 | ... | ... | ... | ... | 1 | 2 | 47 | 28 | 168 | 215 | 885 | 1,100 |
| Inveraray, | ... | ... | ... | ... | ... | 1 | 1 | 1 | 68 | 7 | 84 | 152 | 1,440 | 1,592 |
| Rothesay, | ... | ... | ... | ... | ... | ... | ... | 6 | 70 | 7 | 72 | 142 | 385 | 527 |
| Greenock, | ... | ... | ... | ... | ... | ... | ... | 1 | 25 | 1 | 2 | 27 | 106 | 133 |
| Ballantrae, | ... | ... | ... | ... | ... | ... | ... | 1 | 15 | ... | ... | 15 | 155 | 170 |
| Totals, | 28 | 17 | 2 | 5 | 7 | 11 | 70 | 55 | 7,393 | 239 | 3,197 | 10,590 | 43,002 | 53,592 |

## APPENDIX D.—No. VII.

REGISTRATION OF FISHING BOATS.—ABSTRACT RETURN, by Districts, of Proceedings in SCOTLAND in the Year 1891, under Sea Fisheries Acts of 1868 and 1883, and Sea Fisheries (Scotland) Amendment Act of 1885.

| Districts. | Applications to Register. | | | | Certificates Issued. | | | | Certificates Examined and Endorsed. | | | | Boats Detained. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | First Class. | Second Class. | Third Class. | Total. | First Class. | Second Class. | Third Class. | Total. | First Class. | Second Class. | Third Class. | Total. | First Class. | Second Class. | Third Class. | Total. |
| Eyemouth, | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 38 | 27 | ... | 65 |
| Leith, | ... | 8 | 6 | 14 | ... | 7 | 6 | 13 | 13 | 75 | ... | 88 | ... | 3 | 1 | 4 |
| Anstruther, | 26 | 24 | ... | 50 | 25 | 24 | ... | 49 | 247 | 128 | ... | 375 | ... | ... | ... | ... |
| Montrose, | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 6 | ... | 6 |
| Stonehaven | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 6 | ... | 6 |
| Peterhead, | ... | ... | ... | ... | ... | ... | ... | ... | 229 | 175 | 65 | 469 | ... | ... | ... | ... |
| Fraserburgh, | 26 | 8 | 4 | 38 | 26 | 8 | 4 | 38 | 211 | 83 | 235 | 529 | 6 | 4 | ... | 10 |
| Banff, | 16 | 28 | ... | 44 | 16 | 28 | ... | 44 | 191 | 260 | ... | 451 | ... | ... | ... | ... |
| Buckie, | 26 | 9 | ... | 35 | 24 | 9 | ... | 33 | 194 | 67 | ... | 261 | ... | ... | ... | ... |
| Findhorn, | 1 | 1 | ... | 2 | 1 | 1 | ... | 2 | 1 | 7 | 1 | 9 | 1 | ... | ... | 1 |
| Cromarty, | 1 | 5 | ... | 6 | 1 | 5 | ... | 6 | 15 | 23 | 16 | 54 | ... | ... | ... | ... |
| Helmsdale, | 7 | 3 | ... | 10 | 7 | 3 | ... | 10 | 44 | 29 | ... | 73 | ... | ... | ... | ... |
| Lybster, | 7 | ... | ... | 7 | 7 | ... | ... | 7 | 80 | 15 | ... | 95 | ... | ... | ... | ... |
| Wick, | 26 | 3 | ... | 29 | 26 | 3 | ... | 29 | 252 | 99 | ... | 351 | ... | ... | ... | ... |
| Orkney, | 1 | 6 | ... | 7 | 1 | 6 | ... | 7 | 8 | 28 | ... | 36 | ... | ... | ... | ... |
| Stornoway, | 2 | 9 | 2 | 13 | 2 | 9 | 2 | 13 | 9 | 33 | 22 | 64 | ... | ... | ... | ... |
| Loch Broom, | 7 | 8 | 13 | 28 | 7 | 8 | 13 | 28 | 40 | 112 | 71 | 223 | ... | 4 | 5 | 9 |
| Loch Carron & Skye, | 2 | 35 | 24 | 61 | 2 | 35 | 24 | 61 | 15 | 343 | 339 | 697 | ... | ... | ... | ... |
| Fort-William, | 1 | 4 | 4 | 9 | 1 | 4 | 4 | 9 | 3 | 97 | 106 | 206 | ... | ... | ... | ... |
| Campbeltown, | 1 | 24 | ... | 25 | 1 | 24 | ... | 25 | 31 | 229 | ... | 260 | ... | 6 | ... | 6 |
| Inveraray, | ... | 19 | ... | 19 | ... | 19 | ... | 19 | 7 | 317 | ... | 324 | ... | 28 | ... | 28 |
| Rothesay, | ... | 16 | 15 | 31 | ... | 16 | 15 | 31 | 4 | 168 | 26 | 198 | ... | 6 | 1 | 7 |
| Greenock, | ... | ... | ... | ... | ... | ... | ... | ... | ... | 43 | ... | 43 | ... | ... | ... | ... |
| Ballantrae, | ... | 6 | ... | 6 | ... | 6 | ... | 6 | ... | 191 | ... | 191 | ... | ... | ... | ... |
| Totals, | 150 | 216 | 68 | 434 | 147 | 215 | 68 | 430 | 1,594 | 2,522 | 881 | 4,997 | 45 | 90 | 7 | 142 |

APPENDIX D.—No. VIII.

FISHERY STATISTICS.—RETURN of the Number of Boats, Beam Trawl Vessels, and Resident Fishermen and Boys, in the Fishing Villages or Creeks round the Coasts of SCOTLAND, for the Year 1891.

| CREEKS. | Number of Boats. 1st Class, 30 ft. Keel and upwards. | 2nd Class, 18 ft. to 30 ft. Keel. | 3rd Class, under 18 ft. Keel. | Number of Beam Trawl Vessels. | Total Number of Boats and Beam Trawl Vessels. | Resident Fishermen and Boys. |
|---|---|---|---|---|---|---|
| *Eyemouth District.* | | | | | | |
| Amble, | 6 | ... | 2 | ... | 8 | 16 |
| Alnmouth, | ... | 10 | 2 | ... | 12 | 16 |
| Boulmer, | 5 | 23 | 3 | ... | 31 | 45 |
| Craster, | 15 | 25 | 6 | ... | 46 | 58 |
| Newton, | 9 | 13 | 2 | ... | 24 | 32 |
| Beadnell, | 9 | 16 | 3 | ... | 28 | 45 |
| North Sunderland, | 18 | 18 | 9 | ... | 45 | 68 |
| Holy Island, | 10 | 19 | 12 | ... | 41 | 78 |
| Spittal, | 5 | 12 | 5 | ... | 22 | 60 |
| Berwick, | 15 | 23 | 3 | ... | 41 | 91 |
| Burnmouth, | 18 | 4 | 21 | ... | 43 | 112 |
| Eyemouth, | 66 | 10 | 14 | ... | 90 | 310 |
| Coldingham, | 23 | 9 | 17 | ... | 49 | 85 |
| Total, | 199 | 182 | 99 | ... | 480 | 1,016 |
| *Leith District.* | | | | | | |
| Cove, | ... | 18 | ... | ... | 18 | 24 |
| Dunbar, | 6 | 44 | ... | ... | 50 | 142 |
| North Berwick, | 7 | 16 | ... | ... | 23 | 60 |
| Port Seton and Cockenzie, | 60 | 43 | ... | ... | 103 | 405 |
| Prestonpans, | 6 | 6 | ... | ... | 12 | 90 |
| Fisherrow, | 27 | 17 | ... | ... | 44 | 273 |
| Leith, | 10 | 4 | ... | 3 | 17 | 92 |
| Newhaven, | 22 | 114 | 3 | ... | 139 | 370 |
| Granton, | 4 | 1 | ... | 15 | 20 | 140 |
| Queensferry, | ... | 6 | ... | ... | 6 | 22 |
| Bo'ness, | ... | 2 | ... | ... | 2 | 4 |
| Alloa, | 12 | 12 | ... | ... | 24 | 55 |
| Kincardine, | 3 | 3 | ... | ... | 6 | 18 |
| Limekilns, | ... | 6 | 2 | ... | 8 | 18 |
| Inverkeithing, | ... | 4 | ... | ... | 4 | 14 |
| Aberdour, | ... | 4 | ... | ... | 4 | 14 |
| Burntisland, | ... | 5 | 3 | ... | 8 | 20 |
| Kinghorn, | ... | 6 | 10 | ... | 16 | 25 |
| Kirkcaldy, | ... | 2 | 23 | ... | 25 | 40 |
| Dysart, | ... | 6 | 8 | ... | 14 | 28 |
| Wemyss, | ... | 1 | 6 | ... | 7 | 14 |
| Total, | 157 | 320 | 55 | 18 | 550 | 1,868 |
| *Anstruther District.* | | | | | | |
| Buckhaven, | 89 | 59 | 7 | ... | 155 | 360 |
| Methil and Leven, | ... | 1 | 3 | ... | 4 | 8 |
| Largo, | 13 | 13 | 5 | ... | 31 | 75 |
| Elie and Earlsferry, | ... | 5 | 6 | ... | 11 | 18 |
| St Monance, | 78 | 18 | ... | ... | 96 | 385 |
| Pittenweem, | 51 | 16 | 2 | ... | 69 | 230 |
| Anstruther and Cellardyke, | 156 | 11 | 13 | 1 | 181 | 630 |
| Crail, | 2 | 17 | 15 | ... | 34 | 80 |
| Kingsbarns and Boarhills, | ... | 2 | 4 | ... | 6 | 21 |
| St Andrews, | 30 | 14 | 3 | 2 | 49 | 170 |
| Tayport, | 2 | 37 | 7 | ... | 46 | 110 |
| Newburgh, | 30 | ... | 30 | ... | 60 | 90 |
| Total, | 451 | 193 | 95 | 3 | 742 | 2,177 |

APPENDIX D.—No. VIII.—*Continued.*

| CREEKS. | Number of Boats. 1st Class, 30 ft. Keel and upwards. | 2nd Class, 18 ft. to 30 ft. Keel. | 3rd Class, under 18 ft. Keel. | Number of Beam Trawl Vessels. | Total Number of Boats and Beam Trawl Vessels. | Resident Fishermen and Boys. |
|---|---|---|---|---|---|---|
| *Montrose District.* | | | | | | |
| Dundee, - - - - - | 2 | ... | ... | 2 | 4 | 22 |
| Broughty Ferry, - - | 29 | 30 | 70 | ... | 129 | 190 |
| Westhaven, - - - - | ... | 5 | 4 | ... | 9 | 19 |
| Easthaven, - - - - | ... | 4 | 6 | ... | 10 | 19 |
| Arbroath, - - - - - | 49 | 29 | 10 | ... | 88 | 176 |
| Auchmithie, - - - - | 8 | 25 | 2 | ... | 35 | 61 |
| Usan, - - - - - | 1 | 6 | 2 | ... | 9 | 28 |
| Ferryden, - - - - - | 53 | 39 | 60 | ... | 151 | 296 |
| Montrose, - - - - - | ... | ... | 14 | 3 | 17 | 48 |
| Milton, - - - - - | ... | ... | 3 | ... | 3 | 7 |
| Johnshaven, - - - - | 16 | 27 | 15 | ... | 58 | 118 |
| Gourdon, - - - - - | 44 | 64 | 14 | ... | 122 | 268 |
| Total, - - | 201 | 229 | 200 | 5 | 635 | 1,252 |
| *Stonehaven District.* | | | | | | |
| Shieldhill, - - - - - | ... | 3 | 3 | ... | 6 | 9 |
| Catterline, - - - - | 6 | 5 | 13 | ... | 24 | 39 |
| Crawton, - - - - - | 1 | 4 | 5 | ... | 10 | 12 |
| Stonehaven, - - - - | 74 | 26 | 16 | ... | 116 | 330 |
| Cowie, - - - - - | 5 | 6 | 4 | ... | 15 | 35 |
| Skateraw, - - - - - | 19 | 1 | 12 | ... | 32 | 58 |
| Total, - - | 105 | 45 | 53 | ... | 203 | 483 |
| *Aberdeen District.* | | | | | | |
| Downies, - - - - - | 4 | 4 | 10 | ... | 18 | 35 |
| Portlethen, - - - - | 14 | 14 | 14 | ... | 42 | 90 |
| Findon, - - - - - | ... | ... | 1 | ... | 1 | 4 |
| Cove, - - - - - | 5 | 8 | 8 | ... | 21 | 66 |
| Torry, - - - - - | 50 | 52 | 6 | ... | 108 | 354 |
| Aberdeen, - - - - - | 38 | 18 | 4 | 34 | 94 | 418 |
| Total, - - | 111 | 96 | 43 | 34 | 284 | 967 |
| *Peterhead District.* | | | | | | |
| Newburgh, - - - - | ... | 3 | 2 | ... | 5 | 17 |
| Collieston, - - - - | 14 | 27 | 1 | ... | 42 | 103 |
| Old Castle, - - - - | 3 | 11 | ... | ... | 14 | 30 |
| Whinnyfold, - - - - | 8 | 11 | 4 | ... | 23 | 37 |
| Port Erroll, - - - - | 24 | 9 | 7 | ... | 40 | 70 |
| Bullers of Buchan, - - | 3 | 2 | 3 | ... | 8 | 12 |
| Boddam, - - - - - | 92 | 15 | 2 | ... | 109 | 198 |
| Burnhaven, - - - - | 3 | 5 | 9 | ... | 17 | 18 |
| Peterhead, - - - - | 115 | 34 | 30 | ... | 179 | 390 |
| Buchanhaven, - - - - | 52 | 11 | 8 | ... | 71 | 173 |
| Total, - - | 314 | 128 | 66 | ... | 508 | 1,048 |

APPENDIX D.—No. VIII.—*Continued.*

| CREEKS. | Number of Boats. 1st Class, 30 ft. Keel and upwards. | 2nd Class, 18 ft. to 30 ft. Keel. | 3rd Class, under 18 ft. Keel. | Number of Beam Trawl Vessels. | Total Number of Boats and Beam Trawl Vessels. | Resident Fishermen and Boys. |
|---|---|---|---|---|---|---|
| *Fraserburgh District.* | | | | | | |
| St Combs, - - - - | 36 | 8 | 66 | ... | 110 | 126 |
| Charlestown, - - - | 5 | 3 | 7 | ... | 15 | 26 |
| Inverallochy, - - - | 50 | 14 | 58 | ... | 122 | 204 |
| Cairnbulg, - - - | 27 | 10 | 38 | ... | 75 | 135 |
| Fraserburgh and Broadsea, - | 80 | 43 | 50 | ... | 173 | 418 |
| Pittulie and Sandhaven, - | 16 | 12 | 12 | ... | 40 | 82 |
| Rosehearty, - - - | 43 | 16 | 26 | ... | 85 | 174 |
| Pennan, - - - - | 9 | 9 | 18 | ... | 36 | 65 |
| Total, - - | 266 | 115 | 275 | ... | 656 | 1,230 |
| *Banff District.* | | | | | | |
| Crovie, - - - - | 17 | 15 | 25 | ... | 57 | 118 |
| Gardenstown, - - - | 46 | 20 | 21 | ... | 87 | 200 |
| Macduff, - - - - | 49 | 29 | 12 | ... | 90 | 272 |
| Banff, - - - - | 38 | 4 | 6 | ... | 48 | 154 |
| Whitehills, - - - | 28 | 40 | 25 | ... | 93 | 230 |
| Portsoy, - - - - | 27 | 7 | 12 | ... | 46 | 146 |
| Sandend, - - - - | 13 | 12 | 12 | ... | 37 | 82 |
| Total, - - | 218 | 127 | 113 | ... | 458 | 1,202 |
| *Buckie District.* | | | | | | |
| Cullen, - - - - | 71 | 10 | 13 | ... | 94 | 280 |
| Portknockie, - - - | 77 | 11 | 27 | ... | 115 | 310 |
| Findochty, - - - | 67 | 15 | 27 | ... | 109 | 264 |
| Portessie, - - - - | 81 | 9 | 19 | ... | 109 | 345 |
| Buckie, - - - - | 196 | 17 | 15 | ... | 228 | 796 |
| Portgordon, - - - | 62 | 9 | 7 | ... | 78 | 250 |
| Total, - - | 554 | 71 | 108 | ... | 733 | 2,245 |
| *Findhorn District.* | | | | | | |
| Lossiemouth, - - - | 115 | 14 | 4 | ... | 133 | 483 |
| Hopeman, - - - - | 62 | 22 | 3 | ... | 87 | 280 |
| Burghead, - - - - | 35 | 12 | 5 | ... | 52 | 194 |
| Findhorn, - - - - | 1 | 6 | 1 | ... | 8 | 38 |
| Nairn, - - - - | 37 | 35 | 2 | ... | 74 | 224 |
| Campbeltown, - - - | 8 | 8 | 1 | ... | 17 | 50 |
| Petty, - - - - | 2 | 2 | 2 | ... | 6 | 14 |
| Inverness, - - - - | ... | 7 | ... | ... | 7 | 20 |
| Total, - - | 260 | 106 | 18 | ... | 384 | 1,303 |
| *Cromarty District.* | | | | | | |
| Craigton and Kilmuir, - | ... | 6 | ... | ... | 6 | 30 |
| Avoch, - - - - | 38 | 41 | 6 | ... | 85 | 224 |
| Fortrose and Rosemarkie, - | ... | ... | 4 | ... | 4 | 16 |
| Cromarty, - - - | 17 | 36 | 2 | ... | 55 | 150 |
| Invergordon, &c., - - | ... | ... | 6 | ... | 6 | 24 |
| Balintrad, - - - - | ... | ... | 2 | ... | 2 | 8 |
| Nigg, - - - - | 1 | ... | 7 | ... | 8 | 27 |
| Shandwick, - - - | 6 | 6 | 1 | ... | 13 | 34 |
| Balintore, - - - - | 15 | 8 | 2 | ... | 25 | 77 |
| Hilton, - - - - | 11 | 8 | 6 | ... | 25 | 83 |
| Rockfield, - - - - | 7 | 5 | 4 | ... | 16 | 51 |
| Portmahomack, - - - | 17 | 5 | 5 | ... | 27 | 100 |
| Inver, - - - - | 14 | 7 | 4 | ... | 25 | 81 |
| Total, - - | 126 | 122 | 49 | ... | 297 | 905 |

APPENDIX D.—No. VIII.—*Continued.*

| CREEKS. | Number of Boats. 1st Class, 30 ft. Keel and upwards. | 2nd Class, 18 ft. to 30 ft. Keel. | 3rd Class, under 18 ft. Keel. | Number of Beam Trawl Vessels. | Total Number of Boats and Beam Trawl Vessels. | Resident Fishermen and Boys. |
|---|---|---|---|---|---|---|
| *Helmsdale District.* | | | | | | |
| Embo, | 27 | 14 | 3 | ... | 44 | 94 |
| Golspie, | 14 | 13 | 2 | ... | 29 | 58 |
| Brora, | 15 | 10 | 3 | ... | 28 | 64 |
| Portgower, | 6 | 4 | 1 | ... | 11 | 21 |
| Helmsdale, | 18 | 8 | 13 | ... | 39 | 68 |
| Navidale, | ... | ... | 2 | ... | 2 | 8 |
| Berriedale, | ... | ... | 4 | ... | 4 | 16 |
| Dunbeath, | 20 | 1 | 17 | ... | 38 | 88 |
| Total, | 100 | 50 | 45 | ... | 195 | 417 |
| *Lybster District.* | | | | | | |
| Latheronwheel, | 9 | 3 | 12 | ... | 24 | 62 |
| Forse, | 10 | 5 | 4 | ... | 19 | 42 |
| Lybster, | 69 | 6 | 9 | ... | 84 | 280 |
| Clyth, | 8 | 6 | 7 | ... | 21 | 84 |
| Total, | 96 | 20 | 32 | ... | 148 | 468 |
| *Wick District.* | | | | | | |
| Whaligoe, | 6 | 2 | 6 | ... | 14 | 50 |
| Sarclet, | 7 | 2 | 5 | ... | 14 | 54 |
| Wick and Pulteney, | 201 | 13 | 47 | ... | 261 | 740 |
| Boathaven to Elzie, | 8 | 3 | 8 | ... | 19 | 40 |
| Staxigoe, | 5 | 6 | 7 | ... | 18 | 41 |
| Ackergill, | 4 | 3 | 6 | ... | 13 | 24 |
| Keiss, | 21 | 2 | 26 | ... | 49 | 122 |
| Nybster and Auckingill, | 3 | 1 | 12 | ... | 16 | 40 |
| Freswick, | 3 | ... | 14 | ... | 17 | 58 |
| Duncansbay and Huna, | 5 | ... | 26 | ... | 31 | 71 |
| Stroma, | 9 | 2 | 44 | ... | 55 | 120 |
| Gills and Mey, | 5 | ... | 21 | ... | 26 | 70 |
| Scarfskerry and Ham, | 1 | ... | 12 | ... | 13 | 50 |
| Brough and Dunnet, | ... | ... | 17 | ... | 17 | 45 |
| Castlehill and Murkle, | ... | ... | 9 | ... | 9 | 28 |
| Thurso and Scrabster, | 12 | 12 | 12 | ... | 36 | 80 |
| Crosskirk and Brims, | 1 | 2 | 8 | ... | 11 | 26 |
| Sandside, | ... | 2 | 8 | ... | 10 | 28 |
| Portskerra, | 8 | 5 | 9 | ... | 22 | 92 |
| Strathypoint, | 2 | 1 | 6 | ... | 9 | 24 |
| Armadale, | 2 | 3 | 5 | ... | 10 | 34 |
| Kirtomy and Farr, | 7 | ... | 9 | ... | 16 | 62 |
| Island Roan, Skerry and Torrisdale, | 5 | ... | 20 | ... | 25 | 128 |
| Coldibacky and Scullomy, | ... | ... | 4 | ... | 4 | 18 |
| Talmine and Portvasgo, | 4 | 1 | 16 | ... | 21 | 75 |
| Erriboll, Rispond and Smoo, | ... | ... | 33 | ... | 33 | 90 |
| Total, | 319 | 60 | 390 | ... | 769 | 2,210 |

APPENDIX D.—No. VIII.—*Continued.*

| CREEKS. | Number of Boats. 1st Class, 30 ft. Keel and upwards. | 2nd Class, 18 ft. to 30 ft. Keel. | 3rd Class, under 18 ft. Keel. | Number of Beam Trawl Vessels. | Total Number of Boats and Beam Trawl Vessels. | Resident Fishermen and Boys. |
|---|---|---|---|---|---|---|
| *Orkney District.* | | | | | | |
| Burwick, | 3 | 1 | 11 | ... | 15 | 50 |
| Grimness, | 14 | 1 | 16 | ... | 31 | 126 |
| St Margarets Hope, | 15 | 4 | 18 | ... | 37 | 140 |
| Herston, | 4 | 1 | 6 | ... | 11 | 28 |
| Swona, | ... | ... | 7 | ... | 7 | 14 |
| Walls, | 9 | 1 | 15 | ... | 25 | 92 |
| Flotta, | 7 | 1 | 13 | ... | 21 | 76 |
| Fara, South, | 1 | ... | 2 | ... | 3 | 12 |
| Cava, | ... | ... | 2 | ... | 2 | 6 |
| Hoy, | 4 | ... | 6 | ... | 10 | 40 |
| Graemsay, | ... | ... | 6 | ... | 6 | 18 |
| Stromness, | 7 | 2 | 12 | ... | 21 | 79 |
| Orphir and Scapa, | 1 | 4 | 12 | ... | 17 | 58 |
| Holm, | 13 | ... | 8 | ... | 21 | 70 |
| Burray, | 22 | 1 | 15 | ... | 38 | 98 |
| Deerness, | 7 | ... | 10 | ... | 17 | 60 |
| Tankerness, | 2 | ... | 5 | ... | 7 | 23 |
| Kirkwall, | 13 | 3 | 20 | ... | 36 | 156 |
| Evie and Birsay, | 4 | ... | 16 | ... | 20 | 70 |
| Rousay, | 1 | ... | 20 | ... | 21 | 45 |
| Weir, | ... | ... | 2 | ... | 2 | 3 |
| Egilshay, | ... | ... | 4 | ... | 4 | 12 |
| Shapinshay, | 6 | ... | 15 | ... | 21 | 75 |
| Stronsay, | 13 | 2 | 16 | ... | 31 | 100 |
| Eday, | 4 | 1 | 18 | ... | 23 | 94 |
| Fara, North, | ... | ... | 2 | ... | 2 | 8 |
| Westray and Papa Westray, | 9 | 14 | 130 | ... | 153 | 450 |
| Sanday, | 3 | 1 | 14 | ... | 18 | 60 |
| North Ronaldshay, | 9 | ... | 25 | ... | 34 | 75 |
| Total, | 171 | 37 | 446 | ... | 654 | 2,138 |
| *Shetland District.* | | | | | | |
| Dunrossness, | 4 | 11 | 28 | ... | 43 | 176 |
| Levenwick, | 5 | 7 | 6 | ... | 18 | 72 |
| Hoswick, | 6 | 6 | 8 | ... | 20 | 80 |
| Sandsair, | 8 | 3 | 7 | ... | 18 | 72 |
| Aithsvoe, | 12 | 4 | 9 | ... | 25 | 102 |
| Bressay, | 7 | ... | 7 | ... | 14 | 48 |
| Lerwick, | 67 | 6 | 26 | ... | 99 | 448 |
| Nesting, | 9 | ... | 4 | ... | 13 | 54 |
| Whalsay, | 23 | 1 | 24 | ... | 48 | 154 |
| Skerries, | 3 | 2 | 6 | ... | 11 | 30 |
| Vidlin, | 7 | 3 | ... | ... | 10 | 60 |
| Dalesvoe, | 5 | ... | 5 | ... | 10 | 30 |
| Mossbank, | 3 | ... | 7 | ... | 10 | 20 |
| Burravoe, | 3 | ... | 4 | ... | 7 | 18 |
| Gussaburgh, | ... | ... | 3 | ... | 3 | 9 |
| Midyell, | 12 | ... | 14 | ... | 26 | 72 |
| Gutcher, | 4 | 4 | 6 | ... | 14 | 38 |
| Cullivoe, | 3 | 8 | 10 | ... | 21 | 45 |
| Fetlar, | 1 | 3 | 6 | ... | 10 | 20 |
| Uyasound, | 14 | 2 | 21 | ... | 37 | 104 |
| Baltasound, | 4 | ... | 5 | ... | 9 | 24 |
| Haroldswick, | 1 | 6 | 11 | ... | 18 | 42 |
| Carry forward, | 201 | 66 | 217 | ... | 484 | 1,718 |

APPENDIX D.—No. VIII.—*Continued.*

| CREEKS. | Number of Boats. 1st Class, 30 ft. Keel and upwards. | 2nd Class, 18 ft. to 30 ft. Keel. | 3rd Class, under 18 ft. Keel. | Number of Beam Trawl Vessels. | Total Number of Boats and Beam Trawl Vessels. | Resident Fishermen and Boys. |
|---|---|---|---|---|---|---|
| Brought forward, - | 201 | 66 | 217 | ... | 484 | 1,718 |
| *Shetland District—continued.* | | | | | | |
| Norwick, - - - - - | 1 | 4 | 5 | ... | 10 | 30 |
| Burrafirth, - - - - | ... | 7 | 9 | ... | 16 | 42 |
| West Sandwick, - - - | 4 | ... | 8 | ... | 12 | 24 |
| Fethaland, - - - - | ... | 12 | 14 | ... | 26 | 72 |
| Ollaberry, - - - - - | ... | ... | 20 | ... | 20 | 28 |
| Sandvoe, - - - - - | ... | 3 | ... | ... | 3 | 18 |
| Ronasvoe, - - - - - | ... | 5 | 4 | ... | 9 | 30 |
| Stennis, - - - - - | ... | 18 | 3 | ... | 21 | 108 |
| Hillswick, - - - - | 4 | ... | 20 | ... | 24 | 30 |
| Papa Stour, - - - - | 8 | 1 | 12 | ... | 21 | 66 |
| Sandness, - - - - - | 3 | 2 | 10 | ... | 15 | 44 |
| Vaila Sound, - - - | 10 | ... | 14 | ... | 24 | 71 |
| Skeld, - - - - - | 3 | ... | 4 | ... | 7 | 22 |
| Raewick, - - - - - | 5 | ... | 3 | ... | 8 | 40 |
| Sand, - - - - - | 4 | ... | 4 | ... | 8 | 30 |
| Whiteness, - - - - | 8 | ... | 10 | ... | 18 | 58 |
| Burwick, - - - - - | 2 | ... | 3 | ... | 5 | 14 |
| Scalloway, - - - - | 8 | ... | 44 | ... | 52 | 116 |
| Oxna, - - - - - | 2 | ... | 4 | ... | 6 | 16 |
| Trondra, - - - - - | 4 | ... | 3 | ... | 7 | 28 |
| Burra Isle, - - - - | 14 | ... | 12 | ... | 26 | 98 |
| Havera, - - - - - | ... | ... | 6 | ... | 6 | 26 |
| Maywick, - - - - - | ... | ... | 8 | ... | 8 | 25 |
| Spiggie, - - - - - | 2 | ... | 2 | ... | 4 | 18 |
| Queendale, - - - - | ... | ... | 9 | ... | 9 | 27 |
| Foula Isle, - - - - | 2 | 5 | ... | ... | 7 | 42 |
| Fair Isle, - - - - - | ... | ... | 9 | ... | 9 | 36 |
| Total, - - | 285 | 123 | 457 | ... | 865 | 2,877 |
| *Stornoway District.* | | | | | | |
| Europia, - - - - - | ... | 3 | 3 | ... | 6 | 40 |
| Stow, - - - - - | ... | 6 | 3 | ... | 9 | 42 |
| Portness, - - - - - | 3 | 37 | 6 | ... | 46 | 250 |
| Skegersta, - - - - - | ... | 7 | 4 | ... | 11 | 40 |
| Tolsta, - - - - - | 6 | 9 | 4 | ... | 19 | 60 |
| Glen, - - - - - | 1 | 1 | 1 | ... | 3 | 14 |
| Coll - - - - - | ... | 8 | 6 | ... | 14 | 120 |
| Back, - - - - - | 7 | 11 | 3 | ... | 21 | 130 |
| Vatisker, - - - - - | 5 | 9 | 4 | ... | 18 | 150 |
| Tong, - - - - - | 10 | 9 | 6 | ... | 25 | 100 |
| Stenish, - - - - - | ... | ... | 4 | ... | 4 | 10 |
| Melbost, - - - - - | 2 | 5 | 5 | ... | 12 | 60 |
| Garrabost, - - - - - | 10 | 8 | 10 | ... | 28 | 100 |
| Shadder, - - - - - | 7 | 4 | 3 | ... | 14 | 60 |
| Portnagurin, - - - - | 12 | 12 | 6 | ... | 30 | 170 |
| Portvoller, - - - - | 4 | 5 | 6 | ... | 15 | 85 |
| Sheshader, - - - - | 7 | 6 | 2 | ... | 15 | 70 |
| Bayble, - - - - - | 24 | 25 | 15 | ... | 64 | 260 |
| Knock, - - - - - | 7 | 9 | 4 | ... | 20 | 45 |
| Swordle, - - - - - | 5 | 6 | 4 | ... | 15 | 50 |
| Holm, - - - - - | ... | 3 | 4 | ... | 7 | 18 |
| Sandwick, - - - - - | ... | 2 | 6 | ... | 8 | 20 |
| Stornoway, - - - - | ... | 3 | 15 | ... | 18 | 25 |
| Grimshader, - - - - | 2 | 5 | 2 | ... | 9 | 40 |
| Ranish, - - - - - | 6 | 8 | 4 | ... | 18 | 55 |
| Carry forward, - - | 118 | 201 | 130 | ... | 449 | 2,014 |

APPENDIX D.—No. VIII.—*Continued.*

| CREEKS. | Number of Boats. 1st Class, 30 ft. Keel and upwards. | 2nd Class, 18 ft. to 30 ft. Keel. | 3rd Class, under 18 ft. Keel. | Number of Beam Trawl Vessels. | Total Number of Boats and Beam Trawl Vessels. | Resident Fishermen and Boys. |
|---|---|---|---|---|---|---|
| Brought forward, | 118 | 201 | 130 | ... | 449 | 2,014 |
| *Stornoway District—continued.* | | | | | | |
| Crossbost, | 9 | 10 | 6 | ... | 25 | 60 |
| Leurbost | 7 | 9 | 7 | ... | 23 | 70 |
| Keose, | 3 | ... | 4 | ... | 7 | 20 |
| Laxay, | 2 | ... | 3 | ... | 5 | 20 |
| Balallan | 1 | ... | 4 | ... | 5 | 50 |
| Habost, | 1 | ... | 6 | ... | 7 | 15 |
| Kershader, | 1 | ... | 2 | ... | 3 | 12 |
| Garryvard, | 1 | ... | 5 | ... | 6 | 18 |
| Cromore, | 3 | 8 | 6 | ... | 17 | 50 |
| Marvick, | 6 | 6 | 8 | ... | 20 | 70 |
| Calbost, | 5 | 6 | 3 | ... | 14 | 50 |
| Gravor, | 7 | 10 | 8 | ... | 25 | 60 |
| Leumeriva, | 6 | 7 | 7 | ... | 20 | 60 |
| Loch Seaforth, | ... | ... | 5 | ... | 5 | 40 |
| Elennenibe, | ... | ... | 2 | ... | 2 | 12 |
| Quilis, | 1 | 2 | 5 | ... | 8 | 10 |
| Scalpay Island, | 10 | 14 | 40 | ... | 64 | 160 |
| Plockerpool, | ... | 13 | 6 | ... | 19 | 50 |
| Orrigo, | ... | 2 | 5 | ... | 7 | 16 |
| Derriclate, | ... | ... | 3 | ... | 3 | 12 |
| Maevig, | 1 | 2 | 4 | ... | 7 | 20 |
| Drimishader, | 1 | 3 | 5 | ... | 9 | 25 |
| Scadabay, | 1 | 3 | 7 | ... | 11 | 20 |
| Grozabay, | ... | 2 | 3 | ... | 5 | 60 |
| Cluer, | ... | ... | 4 | ... | 4 | 20 |
| Stocknish, | 1 | 9 | 6 | ... | 16 | 50 |
| Lochalee, | ... | ... | 6 | ... | 6 | 30 |
| Grocrass, | ... | 2 | 6 | ... | 8 | 25 |
| Manish, | ... | ... | 4 | ... | 4 | 20 |
| Fladavay, | ... | ... | 5 | ... | 5 | 20 |
| Quitinish, | ... | ... | 4 | ... | 4 | 25 |
| Finnisbay, | ... | 11 | 8 | ... | 19 | 70 |
| Strond, | 1 | 6 | 25 | ... | 32 | 90 |
| Tarrinsay, | ... | 2 | 6 | ... | 8 | 30 |
| Airdhasaig | ... | ... | 7 | ... | 7 | 24 |
| Scarf Island, | ... | ... | 6 | ... | 6 | 30 |
| Borve, | ... | 4 | 2 | ... | 6 | 40 |
| Shader, | ... | 1 | 2 | ... | 3 | 10 |
| Barvas, | ... | 4 | 4 | ... | 8 | 50 |
| Arnol, | 1 | 3 | 3 | ... | 7 | 40 |
| Bragor, | 1 | 3 | 5 | ... | 9 | 85 |
| Shawlbost, | ... | 6 | 5 | ... | 11 | 60 |
| Carloway, | 19 | 11 | 7 | ... | 37 | 150 |
| Tolstachulish, | 5 | 5 | 10 | ... | 20 | 50 |
| Tobson, | 2 | 8 | 6 | ... | 16 | 60 |
| Enaclate, | ... | ... | 4 | ... | 4 | 20 |
| Breasclate, | 2 | | 7 | ... | 15 | 80 |
| Geshader, | ... | ... | 4 | ... | 4 | 15 |
| Kirkibost, | 2 | 3 | 3 | ... | 8 | 30 |
| Carrishader, | ... | ... | 5 | ... | 5 | 20 |
| Crulivig, | ... | ... | 3 | ... | 3 | 20 |
| Valtos, | 6 | 12 | 8 | ... | 26 | 120 |
| Kneep, | ... | 5 | 4 | ... | 9 | 30 |
| Airduig, | ... | 4 | 3 | ... | 7 | 30 |
| Crowlista, | 2 | 9 | 6 | ... | 17 | 60 |
| Carry forward, | 226 | 412 | 462 | ... | 1,100 | 4,398 |

APPENDIX D.—No. VIII.—*Continued.*

| CREEKS. | Number of Boats. | | | Number of Beam Trawl Vessels. | Total Number of Boats and Beam Trawl Vessels. | Resident Fishermen and Boys. |
|---|---|---|---|---|---|---|
| | 1st Class, 30 ft. Keel and upwards. | 2nd Class, 18 ft. to 30 ft. Keel. | 3rd Class, under 18 ft. Keel. | | | |
| Brought forward, - | 226 | 412 | 462 | ... | 1,100 | 4,898 |
| *Stornoway District—continued.* | | | | | | |
| Mangersta, - - - - | ... | ... | 3 | ... | 3 | 10 |
| Islivig, - - - - - | 1 | 4 | 6 | ... | 11 | 25 |
| Brenish, - - - - - | ... | 4 | 6 | ... | 10 | 25 |
| Valley, North Uist, - - | ... | ... | 3 | ... | 3 | 15 |
| Lochmaddy, - - - - | ... | 5 | 40 | ... | 45 | 138 |
| Locheport, - - - - | ... | 4 | 27 | ... | 31 | 71 |
| Graemsay Island, - - | ... | 2 | 9 | ... | 11 | 37 |
| Heisker Island, - - - | ... | ... | 9 | ... | 9 | 27 |
| Benbecula Island, - - | ... | 1 | 70 | ... | 71 | 104 |
| Loch Skipport, - - - | ... | 2 | 10 | ... | 12 | 30 |
| Loch Boisdale, - - - | ... | 2 | 72 | ... | 74 | 209 |
| Eriskay Island, - - - | ... | 12 | 12 | ... | 24 | 150 |
| Brurnish Barra, - - | 3 | 3 | 5 | ... | 11 | 50 |
| Bualnabodach, - - - | 1 | 2 | 8 | ... | 11 | 36 |
| Earsary, - - - - - | 1 | 2 | 9 | ... | 12 | 56 |
| Brevig, - - - - - | 3 | 2 | 5 | ... | 10 | 30 |
| Castlebay, - - - - | 8 | 23 | 20 | ... | 51 | 174 |
| Pabbay, - - - - - | ... | ... | 1 | ... | 1 | 5 |
| Minglay, - - - - - | ... | 3 | 3 | ... | 6 | 30 |
| Barrahead, - - - - | ... | ... | 1 | ... | 1 | 3 |
| Borve, - - - - - | ... | ... | 1 | ... | 1 | 3 |
| Total, - - | 243 | 483 | 782 | ... | 1,508 | 5,626 |
| *Loch Broom District.* | | | | | | |
| Poulin, - - - - - | 1 | ... | 6 | ... | 7 | 23 |
| Oldshorebeg and Oldshoremore, - - - - - | 2 | 1 | 18 | ... | 21 | 86 |
| Kinlochbervie, - - - - | 3 | 1 | 6 | ... | 10 | 28 |
| Badcall (Inchard), and Achriskill, - - - | 2 | ... | 10 | ... | 12 | 37 |
| Ardmore and Portlovorchaidh, - - - - | ... | ... | 5 | ... | 5 | 14 |
| Findlemore, and Fanagmore, - - - - | 1 | ... | 5 | ... | 6 | 25 |
| Tarbet and Scourie, - - | 3 | ... | 16 | ... | 19 | 45 |
| Badcaul (Scourie), - - | ... | 1 | 8 | ... | 9 | 28 |
| Glendhu and Unapool, - | ... | ... | 6 | ... | 6 | 23 |
| Ardvar and Nedd, - - | 1 | ... | 6 | ... | 7 | 24 |
| Drumbeg, - - - - - | ... | ... | 6 | ... | 6 | 14 |
| Culkein (Drumbeg), - - | ... | ... | 10 | ... | 10 | 18 |
| Clashnessie, - - - - | 2 | ... | 5 | ... | 7 | 22 |
| Achnacarnin, - - - - | ... | ... | 4 | ... | 4 | 12 |
| Culkein (Stoer), - - - | ... | ... | 4 | ... | 4 | 14 |
| Raffin and Balnacladich, - | ... | ... | 7 | ... | 7 | 24 |
| Clachtoll, - - - - - | 5 | ... | 14 | ... | 19 | 76 |
| Achmelvich, - - - - | 2 | ... | 4 | ... | 6 | 24 |
| Lochinver and Strathan, - | 2 | ... | 8 | ... | 10 | 26 |
| Badnaban and Inverkirkaig, | ... | ... | 10 | ... | 10 | 27 |
| Achnahaird and Reef, - | 1 | 1 | 9 | ... | 11 | 28 |
| Carry forward, - - | 25 | 4 | 167 | ... | 196 | 618 |

APPENDIX D.—No. VIII.—*Continued.*

| CREEKS. | Number of Boats. 1st Class, 30 ft. Keel and upwards. | 2nd Class, 18 ft. to 30 ft. Keel. | 3rd Class, under 18 ft. Keel. | Number of Beam Trawl Vessels. | Total Number of Boats and Beam Trawl Vessels. | Resident Fishermen and Boys. |
|---|---|---|---|---|---|---|
| Brought forward, - | 25 | 4 | 167 | ... | 196 | 618 |
| *Loch Broom District—continued* | | | | | | |
| Altandhu, - - - - - | 3 | 5 | 10 | ... | 18 | 35 |
| Polbain and Tanera, - - | 4 | 11 | 12 | ... | 27 | 65 |
| Achiltibuie and Badenscally, | ... | 5 | 16 | ... | 21 | 60 |
| Polglass and Culnacraig, - | 1 | 3 | 10 | ... | 14 | 42 |
| Isle Martin and Ardmair, - | ... | ... | 7 | ... | 7 | 15 |
| Rhue and Morefield, - - | 3 | ... | 11 | ... | 14 | 35 |
| Ullapool, - - - - - | 1 | 1 | 28 | ... | 30 | 98 |
| Leckmelm and Ardcharnish, | ... | ... | 4 | ... | 4 | 10 |
| Letters, Ardindrean and Rheroy, - - - - | 6 | 1 | 24 | ... | 31 | 94 |
| Achmore and Scoriag, - | 1 | 2 | 14 | ... | 17 | 60 |
| Charnoch and Badralloch, - | ... | 2 | 10 | ... | 12 | 43 |
| Ardessie and Badcall, - | ... | ... | 10 | ... | 10 | 25 |
| Durnmuk and Badlurach, - | ... | ... | 20 | ... | 20 | 74 |
| First and Second Coast, - | ... | ... | 7 | ... | 7 | 27 |
| Sand and Laid, - - | 3 | ... | 9 | ... | 12 | 60 |
| Achgarve and Mellon Udrigle, - - - - | 2 | ... | 5 | ... | 7 | 34 |
| Opinin and Mellon Charles,- | 2 | ... | 6 | ... | 8 | 48 |
| Ormiscraig and Bualnaluil, | 1 | ... | 7 | ... | 8 | 41 |
| Tenefelin and Aultbea, - | 1 | ... | 6 | ... | 7 | 38 |
| Poolewe and Naast, - - | ... | ... | 8 | ... | 8 | 34 |
| Inveresdale, - - - | 1 | 4 | 8 | ... | 13 | 56 |
| Cove, - - - - - | ... | ... | 7 | ... | 7 | 25 |
| Melvaig, - - - - - | 1 | ... | 4 | ... | 5 | 20 |
| North Erradale, - - - | ... | 1 | 3 | ... | 4 | 18 |
| Sand (Gairloch), - - | ... | 4 | 5 | ... | 9 | 44 |
| Strath, - - - - - | 1 | 9 | 4 | ... | 14 | 61 |
| Badachro, - - - - - | 4 | 12 | 4 | ... | 20 | 52 |
| Porthenderson, - - - | 2 | 5 | 5 | ... | 12 | 40 |
| South Erradale, - - | ... | 1 | 2 | ... | 3 | 20 |
| Charleston and Red Point, | 1 | 1 | 3 | ... | 5 | 22 |
| Total, - - | 63 | 71 | 436 | ... | 570 | 1,914 |
| *Loch Carron and Skye District.* | | | | | | |
| Diebig to Ardglass, - - | 2 | ... | 6 | ... | 8 | 26 |
| Loch Torridon, - - - | 1 | 3 | 4 | ... | 8 | 24 |
| Loch Shieldaig, - - - | ... | 4 | 11 | ... | 15 | 45 |
| Ardheslaig to Kenmore, - | 1 | 5 | 5 | ... | 11 | 32 |
| Arinachrinachd to Lonebain, - - - - | ... | 1 | 5 | ... | 6 | 18 |
| Applecross to Ugas, - - | 4 | 22 | 26 | ... | 52 | 130 |
| Kishorn to Kinistin, - - | ... | 4 | 15 | ... | 19 | 57 |
| Aird to Strome, - - - | 1 | 12 | 20 | ... | 33 | 96 |
| Loch Carron, - - - | 1 | 19 | 36 | ... | 56 | 175 |
| Plockton to Balmacara, - | 1 | 27 | 13 | ... | 41 | 130 |
| Lochs Duich and Long, - | ... | 8 | 48 | ... | 56 | 165 |
| Loch Hourn and Glenelg, - | ... | 8 | 34 | ... | 42 | 116 |
| Troternish, - - - | ... | 20 | 4 | ... | 24 | 68 |
| Carry forward, - | 11 | 133 | 227 | ... | 371 | 1,082 |

APPENDIX D.—No. VIII.—*Continued.*

| CREEKS. | Number of Boats. 1st Class, 30 ft. Keel and upwards. | 2nd Class, 18 ft. to 30 ft. Keel. | 3rd Class, under 18 ft. Keel. | Number of Beam Trawl Vessels. | Total Number of Boats and Beam Trawl Vessels. | Resident Fishermen and Boys. |
|---|---|---|---|---|---|---|
| Brought forward, - | 11 | 133 | 227 | ... | 371 | 1,082 |
| *Loch Carron and Skye District—continued.* | | | | | | |
| Portree, - - - | 3 | 15 | 34 | ... | 52 | 170 |
| Balameanoch, - - - | ... | 2 | 23 | ... | 25 | 75 |
| Sconser, - - - - | ... | 3 | 31 | ... | 34 | 102 |
| Luib to Strolomus, - - | 1 | 12 | 48 | ... | 61 | 188 |
| Broadford to Lussay, - - | 1 | 19 | 34 | ... | 54 | 166 |
| Kylea Kin, - - - | ... | 4 | ... | ... | 4 | 15 |
| Sleat, - - - - - | 1 | 26 | 56 | ... | 83 | 247 |
| Uig, - - - - - - | 3 | 23 | 1 | ... | 27 | 80 |
| Snizort, - - - - | ... | 9 | 7 | ... | 16 | 48 |
| Lyndale, - | ... | 17 | 9 | ... | 26 | 78 |
| Waternish, - - - | ... | 11 | ... | ... | 11 | 40 |
| Stein, - - - - - | 1 | 5 | ... | ... | 6 | 29 |
| Dunvegan, - - - | ... | 4 | 2 | ... | 6 | 20 |
| Glendale, - - - - | ... | 12 | ... | ... | 12 | 46 |
| Lochs Bracadale and Brittle, | ... | 1 | 1 | ... | 2 | 6 |
| Straithaird, - - | ... | 5 | 15 | ... | 20 | 60 |
| Lochs Slapin and Eyeshort, - | ... | ... | 27 | ... | 27 | 81 |
| Rona, Raasay and Scalpa, - | 1 | 6 | 20 | ... | 27 | 81 |
| Croulin and Soay, - - | ... | 1 | 5 | ... | 6 | 18 |
| Total, - - | 22 | 308 | 540 | ... | 870 | 2,627 |
| *Fort-William District.* | | | | | | |
| Lochs Nevis and Moror, - | 2 | 13 | 36 | ... | 51 | 106 |
| Arisaig and Loch Aylort, - | ... | 2 | 10 | ... | 12 | 31 |
| Sumisary to Ockle Point and Eilean Shona, - - | ... | 13 | 8 | ... | 21 | 70 |
| Ockle Point to Loch Sunart, | 2 | 11 | 3 | ... | 16 | 42 |
| Loch Sunart and Aline, - | ... | 1 | 13 | ... | 14 | 28 |
| Loch Eil and Fort-William, | ... | 5 | 45 | ... | 50 | 100 |
| Corran, - - - - - | ... | 4 | 7 | ... | 11 | 22 |
| Loch Leven and Kintallen, | ... | 1 | 15 | ... | 16 | 32 |
| Cuil, Port Appin and Loch Creran, - - - - | ... | 3 | 6 | ... | 9 | 18 |
| Loch Etive and Dunstaffnage, - - - - | ... | ... | 5 | ... | 5 | 10 |
| Oban, - - - - - | ... | 20 | 8 | ... | 28 | 52 |
| Lismore, - - - - | ... | 1 | 9 | ... | 10 | 25 |
| Tobermory, - - - | 3 | 12 | 8 | ... | 23 | 50 |
| Lochs Don, Spelve and Buie, | ... | 2 | 8 | ... | 10 | 25 |
| Carsaig to Kentra, - - | ... | 3 | 5 | ... | 8 | 21 |
| Lochs Laich and Scriddan, - | ... | 2 | 10 | ... | 12 | 24 |
| Ulva, Loch-na-Kiel, and Tuadh, - - - - | ... | 2 | 3 | ... | 5 | 15 |
| Coll, - - - - - | ... | 3 | 3 | ... | 6 | 18 |
| Tiree, - - - - - | 3 | 45 | 32 | ... | 80 | 252 |
| Iona, - - - - - | ... | ... | 5 | ... | 5 | 10 |
| Muck, Eigg, Rum, and Canna, | ... | 2 | 6 | ... | 8 | 24 |
| Total, - - | 10 | 145 | 245 | ... | 400 | 975 |

APPENDIX D.—No. VIII.—*Continued.*

| CREEKS. | Number of Boats. 1st Class, 30 ft. Keel and upwards. | 2nd Class, 18 ft. to 30 ft. Keel. | 3rd Class, under 18 ft. Keel. | Number of Beam Trawl Vessels. | Total Number of Boats and Beam Trawl Vessels. | Resident Fishermen and Boys. |
|---|---|---|---|---|---|---|
| *Campbeltown District.* | | | | | | |
| Skipness and Clonaig, - | 1 | 20 | 9 | ... | 30 | 82 |
| Cour and Grogport, - - | ... | 5 | 4 | ... | 9 | 28 |
| Carradale, Torrisdale and Saddell, - - | ... | 54 | 6 | ... | 60 | 214 |
| Campbeltown, Peninver, &c., | 27 | 163 | 12 | 6 | 208 | 653 |
| South end of Kintyre, - | ... | 4 | 4 | ... | 8 | 20 |
| Sanda Island, - - - | ... | 3 | 2 | ... | 5 | 10 |
| Machrihanish, - - - | ... | 5 | 2 | ... | 7 | 14 |
| Ballochantee, - - - | ... | 4 | 5 | ... | 9 | 21 |
| Gigha Island, - - - | 2 | 25 | 10 | ... | 37 | 103 |
| Jura Island, - - - | ... | 2 | 38 | ... | 40 | 44 |
| Colonsay Island, - - | ... | 7 | 14 | ... | 21 | 35 |
| Portnahaven, Islay, - - | 3 | 27 | 52 | ... | 82 | 214 |
| Portwemyss, Islay, - - | ... | 20 | 30 | ... | 50 | 108 |
| Port Charlotte, Islay, - | ... | 10 | 10 | ... | 20 | 39 |
| Bowmore, Islay, - - | ... | 12 | 10 | ... | 22 | 41 |
| Portellen, Islay, - - | ... | 5 | 2 | ... | 7 | 19 |
| Portaskaig, - - - | ... | 5 | 3 | ... | 8 | 21 |
| Lochgrunard, - - | ... | 4 | 6 | ... | 10 | 26 |
| Total, - - | 33 | 375 | 219 | 6 | 633 | 1,692 |
| *Inveraray District.* | | | | | | |
| Loch Feochan, - - - | ... | ... | 11 | ... | 11 | 22 |
| Luing, - - - - - | ... | ... | 18 | ... | 18 | 36 |
| Loch Melfort, - - - | ... | ... | 4 | ... | 4 | 6 |
| Loch Craignish, - - - | ... | ... | 2 | ... | 2 | 4 |
| Crinan, - - - - | ... | ... | 3 | ... | 3 | 4 |
| Loch Sweyn, - - - | ... | ... | 4 | ... | 4 | 5 |
| Loch Kylesport, - - - | ... | ... | 2 | ... | 2 | 3 |
| Tarbert, - - - - | ... | 106 | 18 | ... | 124 | 364 |
| Ardrishaig, - - - | ... | 62 | 20 | ... | 82 | 219 |
| Lochgilphead, - - - | ... | 39 | 6 | ... | 45 | 108 |
| Castleton, - - - - | ... | 19 | 4 | ... | 23 | 60 |
| Lochgair, - - - - | ... | 13 | 4 | ... | 17 | 37 |
| Minard, - - - - | ... | 12 | 3 | ... | 15 | 34 |
| Crarae, - - - - | ... | 7 | 2 | ... | 9 | 16 |
| Furnace, - - - - | ... | 8 | 3 | ... | 11 | 24 |
| Kenmore, - - - - | ... | 4 | 2 | ... | 6 | 8 |
| Inveraray, - - - - | ... | 6 | 5 | ... | 11 | 13 |
| Cairnahu to Newton, - | ... | 15 | 6 | ... | 21 | 29 |
| Otter to Ardlamont, - - | .. | 21 | 4 | ... | 25 | 68 |
| Total, - - | ... | 312 | 121 | ... | 433 | 1,060 |
| *Rothesay District.* | | | | | | |
| Rothesay, - - - - | ... | 14 | 14 | 2 | 30 | 31 |
| Port Bannatyne and North Bute, - - - - - | 1 | 11 | 7 | ... | 19 | 20 |
| Kyles of Bute, - - - - | ... | 19 | 10 | ... | 29 | 65 |
| St Ninians, and West Side of Bute, - - - - - | 2 | 10 | 6 | ... | 18 | 22 |
| Kilchatten and Schoolac, - | ... | 3 | 8 | ... | 11 | 12 |
| Roseneath to Toward, - | ... | 22 | 23 | ... | 45 | 80 |
| Lochranza and Catiool, - | 1 | 21 | 3 | ... | 25 | 45 |
| Pirnmill to Blackwater, - | ... | 20 | 4 | ... | 24 | 45 |
| Blackwater to Whiting Bay, | ... | 3 | 5 | ... | 8 | 12 |
| Whiting Bay to Lamlash, - | ... | 3 | 6 | ... | 9 | 15 |
| Brodick and Corrie, - - | ... | 3 | 3 | ... | 6 | 8 |
| Total, - - | 4 | 129 | 89 | 2 | 224 | 355 |

APPENDIX D.—No. VIII.—*Continued.*

| CREEKS. | Number of Boats. 1st Class, 30 ft. Keel and upwards. | 2nd Class, 18 ft. to 30 ft. Keel. | 3rd Class, under 18 ft. Keel. | Number of Beam Trawl Vessels. | Total Number of Boats and Beam Trawl Vessels. | Resident Fishermen and Boys. |
|---|---|---|---|---|---|---|
| *Greenock District.* | | | | | | |
| Roseneath and Gareloch, - | ... | 6 | 12 | ... | 18 | 33 |
| Helensbro and Dumbarton,- | ... | 4 | 8 | ... | 12 | 20 |
| Glasgow and Paisley, - - | ... | ... | 2 | 1 | 3 | 11 |
| Port-Glasgow, - - - | ... | 1 | 16 | ... | 17 | 30 |
| Greenock, - - - - | ... | 10 | 10 | 9 | 29 | 60 |
| Gourock, - - - - - | ... | 3 | 3 | ... | 6 | 9 |
| Inverkip, - - - - - | ... | ... | 2 | ... | 2 | 4 |
| Largs, - - - - | ... | 3 | 20 | 1 | 24 | 35 |
| Fairlie, - - - - - | ... | ... | 3 | ... | 3 | 6 |
| Cumbraes,- - - - - | ... | 5 | 11 | ... | 16 | 24 |
| Portincross, - - - - | ... | 1 | 6 | 1 | 8 | 10 |
| Saltcoats, - - - - | ... | 20 | 20 | 5 | 45 | 75 |
| Irvine, - - - - - | 1 | 24 | ... | ... | 25 | 54 |
| Troon, - - - - - | ... | 18 | 2 | ... | 20 | 16 |
| Total, - - | 1 | 95 | 115 | 17 | 228 | 387 |
| *Ballantrae District.* | | | | | | |
| Ayr, - - - - - - | 1 | 16 | 16 | ... | 33 | 50 |
| Dunure, - - - - - | ... | 40 | 13 | ... | 53 | 72 |
| Maidens, - - - - - | ... | 18 | 16 | ... | 34 | 56 |
| Girvan, - - - - - | 2 | 50 | 10 | ... | 62 | 140 |
| Carleton, - - - - - | 1 | 12 | 4 | ... | 17 | 40 |
| Ballantrae, - - - - | ... | 30 | 10 | ... | 40 | 84 |
| Cairnryan,- - - - | ... | 2 | 6 | ... | 8 | 24 |
| Stranraer, - - - - | 1 | 15 | 15 | ... | 31 | 58 |
| Portpatrick, - - - - | ... | 3 | 24 | ... | 27 | 60 |
| Stewarton, - - - - | ... | 1 | 12 | ... | 13 | 20 |
| Portlogan,- - - - - | ... | ... | 9 | ... | 9 | 14 |
| Drumore, - - - - - | ... | 8 | 4 | ... | 12 | 33 |
| Sandhead,- - - - - | ... | 1 | 20 | ... | 21 | 22 |
| Glenluce, - - - - - | ... | 4 | 9 | ... | 13 | 28 |
| Port William, - - - - | ... | ... | 28 | ... | 28 | 30 |
| Whitehorn Isle,- - - - | ... | ... | 16 | ... | 16 | 16 |
| Garlieston, - - - - | ... | 4 | 14 | ... | 18 | 16 |
| Kirkcudbright, - - - | ... | ... | 10 | ... | 10 | 12 |
| Carsethorn, - - - - | ... | ... | 5 | ... | 5 | 16 |
| Powfoot, - - - - - | ... | ... | ... | ... | ... | 24 |
| Annan, - - - - - | 46 | ... | 10 | ... | 56 | 94 |
| Total, - - | 51 | 204 | 251 | ... | 506 | 909 |

Fishery Board for Scotland,
Edinburgh, 31st Dec. 1891.

## APPENDIX E.—No. I.

REPORT BY MESSRS D. & T. STEVENSON, ENGINEERS, UPON THE STATE OF HARBOUR WORKS IN PROGRESS UNDER THEIR SUPERVISION, DURING THE YEAR 1891.

**We have the honour to report upon the state of the Harbour Works now in progress under our direction, during the year 1891, as follows :—**

BROADFORD HARBOUR, ISLE OF SKYE.—This harbour, as designed by Messrs Stevenson, the Board's Engineers, was completed during the past season in a satisfactory manner by the contractor, Mr John Best. As will be seen from the plan, the harbour consists of a pier of concrete, extending seawards for a distance of 513 feet into a depth of water of 10 feet at low water, and having a berth on its north side at which steamers can call; while on its south side there is ample quay accommodation for fishing boats. From the outer end of this pier, a pier of greenheart extends for a length of 280 feet, and there terminates in a timber head. This work will be of essential benefit to the fishermen of a large district, as the regular trading steamers will be able to come alongside, at all states of the tide, enabling them to send their catch to the southern markets, and thus securing better prices. In addition to the work originally contracted for, it was deemed desirable to construct a short breakwater on the inner side of the concrete pier to afford additional shelter to the fishing boats. The present approach road to the harbour is somewhat circuitous, with at one part, a steep gradient; and any portion of the Grant available should be devoted to the formation of a road along the shore from the pier to the village of Broadford.

The interior of the harbour was deepened, and boulders were cleared away from the outside of the timber head. The old harbour, which is within the 'Limits of Harbour,' as sanctioned by the Provisional Order, was also deepened.

PORT NESS HARBOUR, ISLAND OF LEWIS.—As mentioned in last year's Report the plans and specification of this harbour, as prepared by Messrs Stevenson, were submitted for contract, when the work was let to Mr Norman Forbes, who began operations in June 1890, and has since prosecuted them, but not so rapidly during the past season as could have been wished, mainly owing to the exceptionally bad weather experienced in the district, accompanied by heavy seas. With more favourable weather it is hoped the contract will be completed early in the season of 1892.

The Secretary for Scotland has succeeded in securing a Grant from the Treasury to meet the cost of erecting a covering breakwater which is absolutely necessary to protect the present harbour and its new entrance, and also to afford protection to the large number of fishing boats which congregate here at particular seasons, as well as to enable steamers to lie alongside and take in cargoes of fish, and will thus allow the fishermen to get the produce of their labours sent, with despatch, to renumerative markets. Messrs Stevenson prepared the design, working plans and specification. Tenders have been received from contractors of standing for the execution of the work, and these are now under consideration.

The Treasury have also made a Grant for further deepening the existing harbour, and this work is now being carried on by Mr Forbes, simultaneously with the work he is executing for the Fishery Board. The plans for this extension were approved of by the Board.

BALINTORE HARBOUR, ROSS-SHIRE.—The works at Balintore were contracted for by Mr G. Pirie, who has prosecuted them under the direction of Messrs Stevenson, during the past season, but owing to bad weather and the risk of the work being damaged by the sea, it was deemed prudent to suspend operations on the outer pier during the dead of winter. 223 yards in length of the main pier have been completed, leaving only about 100 feet to be finished. Whenever the state of the weather and sea permits, this part of the work will be resumed. The Western breakwater is more than half finished, and the excavations are well advanced. Should the weather prove favourable, the harbour will be finished during the season of 1892. Even in its unfinished state the harbour affords sheltered accommodation to the fishing boats, sometimes as many as 30 being in the basin at one time,

and there have also been in the harbour, in addition to the boats, 4 vessels discharging cargoes alongside the quays. The benefit of having a harbour, where no harbour before existed, is greatly appreciated by the fishermen.

COLDINGHAM SHORE HARBOUR, BERWICKSHIRE.—The formation of this deep water fishery harbour towards the cost of which Mr Usher of Northfield has contributed £10,000 and the Board £3000 has been completed. The excavation of the entrance channel, to secure a depth of 4 feet at low water, has been prosecuted during the year 1891, and has proved a very tedious operation, owing to frequent interruptions by the weather; but the works have now been completed, according to the design of Messrs Stevenson, by the contractors Messrs Morrison & Son. As will be seen from the plan, the harbour has an area of 2·1 acres, with quayage extending to 421 yards. The harbour possesses an entrance with a depth of 4 feet at low water of spring tides, and a natural pool inside having a depth of from 4 to 7½ feet at low water springs. The harbour, as completed, will accommodate 125 of the largest sized boats.

BEACON LIGHTS.—With the view of encouraging the fisheries on the West Coast of Scotland, 'the Western Highlands and Islands Commission,' suggested that the Lindberg system of lights which the Commissioners of Northern Lighthouses had introduced at 2 stations, should be extended to other parts of the coast; but as the cost of these lights could not become a charge on the Mercantile Marine Fund, the Secretary for Scotland obtained a Grant to meet the expenditure. The Commissioners of Northern Lighthouses undertook their installation, and have erected lights at Dubh Sgeir and Sgeir Liath, Castle Bay; at Calavay Island, Loch Boisdale; at Carloway, in Lewis; at Weaver Point, Loch Maddy, all in the Hebrides; at Kyle Rhea, Skye, and also a gas-lighted beacon in Oban Bay, near the Dog Stone. All of these lights have been exhibited, and they will be of the greatest service to the fisheries.

D. & T. STEVENSON.

*Edinburgh*, 10*th February* 1892.

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## APPENDIX E.—No. II.

### REPORT BY MR JAMES BARRON, ENGINEER, UPON AUCHMITHIE HARBOUR.

I beg to submit the following Report on Auchmithie Harbour Works:—

The Works have now been practically completed by the contractor, Mr John Malcolm Dunnet.

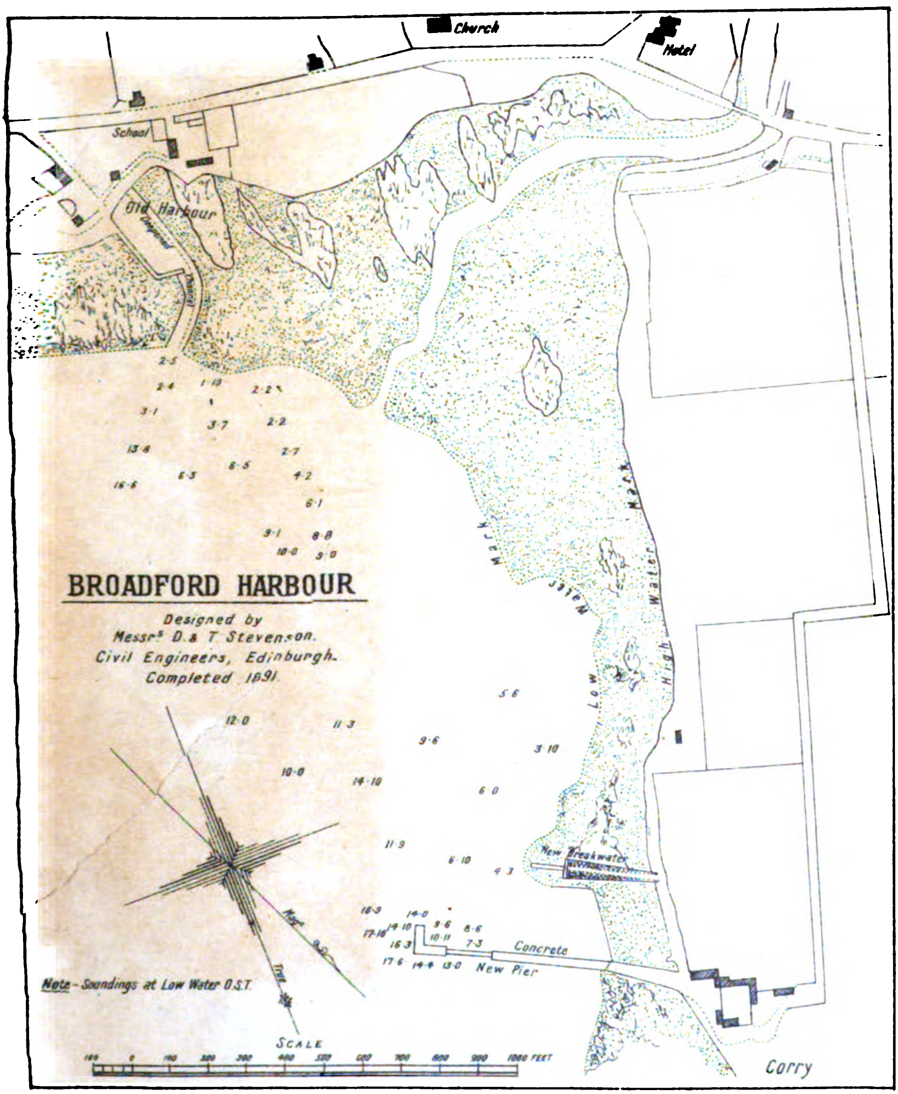
In addition to the Works, as at first proposed, a retaining wall has been erected on south side of Harbour basin, to prevent the loose materials forming the beach from shifting, and also to assist in lessening the run of the sea in the Harbour at time of high-water.

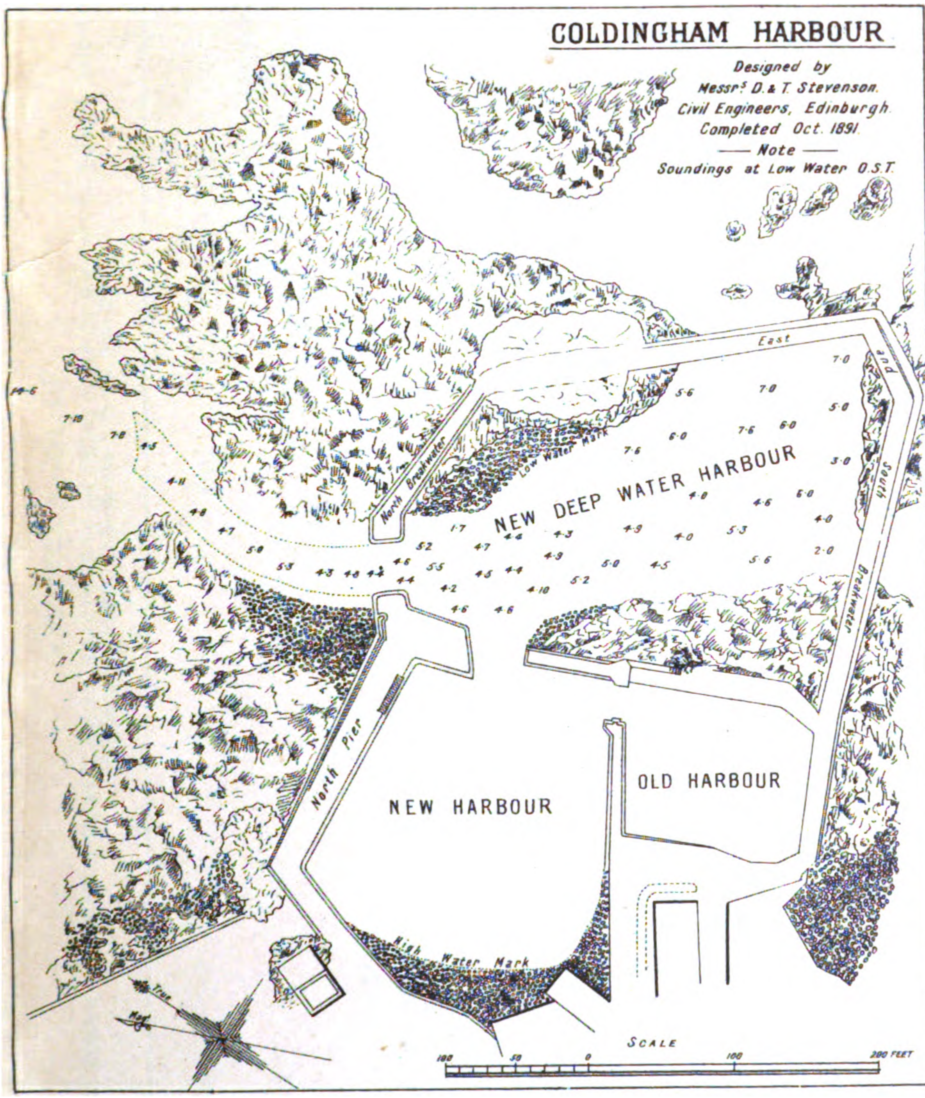
A new road, about 400 yards in length, has also been formed, from the village to the Harbour, with a gradient suited for cart traffic. The area of Harbour basin, and entrance from sea to same, has been deepened to two feet, below low-water level of ordinary spring tides. The rise of tide at Auchmithie being 14 feet, there is thus a depth of 16 feet of water in the Harbour and entrance to same, at time of high-water. The Harbour has all the outer or protecting Works constructed, which would be necessary to admit of the area of the Harbour being enlarged at a future time, and if more funds were available, an enlargement of the basin would be of much benefit.

The Works have been well tested for nearly two winters, and have suffered no damage. Some rocks lying seaward of the Harbour entrance, which presently form an obstruction to navigation, are being reduced, and it is expected that during the low stream tides in March next they will be entirely removed.

JAMES BARRON.

*Aberdeen, January* 1892.


Church
Hotel
School
Old Harbour
BROADFORD HARBOUR
Designed by
Messrs D. & T. Stevenson.
Civil Engineers, Edinburgh.
Completed 1891.
Low Water Mark
High Water Mark
New Breakwater
Concrete
New Pier
Corry
Note - Soundings at Low Water O.S.T.
Scale
1000 FEET


COLDINGHAM HARBOUR
Designed by
Messrs. D. & T. Stevenson.
Civil Engineers, Edinburgh.
Completed Oct. 1891.
Note
Soundings at Low Water O.S.T.
NEW DEEP WATER HARBOUR
North Breakwater
Low Water Mark
East
and
South
Breakwater
North Pier
NEW HARBOUR
OLD HARBOUR
High Water Mark
SCALE
100
50
0
100
200 FEET

## APPENDIX E.—No. III.

HARBOUR WORKS.—ACCOUNT of RECEIPT and EXPENDITURE by the Fishery Board for Scotland, for Building, Extending, and Repairing PIERS and HARBOURS in Scotland, in the year 1891.

*Dr.*

| Date | Particulars | £ s. d. | £ s. d. |
|---|---|---|---|
| 1890. | | | |
| Dec. 31. | To Balance . . . . . . | | £12,997 3 3 |
| | **PARLIAMENTARY GRANT.** | | |
| 1891. | | | |
| Mar. 31. | To Parliamentary Grant for Piers or Quays (5 Geo. IV. cap. 64), year ended 31st March 1891, . . | | 3,000 0 0 |
| | **BANK INTEREST.** | | |
| Feb. 28. | ,, Bank Interest on balance on Deposit Receipt to date. do. do. do. | £79 1 3 | |
| Mar. 31. | ,, do. do. do. | 11 9 3 | |
| May 29. | ,, do. do. do. | 53 16 7 | |
| July 30. | ,, do. do. do. | 40 5 5 | |
| Sept. 30. | ,, do. do. do. | 25 9 6 | |
| Oct. 31. | ,, do do. do. | 10 12 6 | |
| | | | 220 14 6 |
| | Carried over, . | | £16,217 17 9 |

*Cr.*

| Date | Particulars | £ s. d. | £ s. d. |
|---|---|---|---|
| 1891. | | | |
| | *Portknockie Harbour, Banffshire.* | | |
| Dec. 31. | By Payments for the Harbour Works at Portknockie during the year ended this date, viz.:— | | |
| | Works, . . . . . . | £240 3 10 | |
| | Inspector's wages, . . . | 29 13 7 | |
| | | | £269 17 5 |
| | *Broadford Harbour, Island of Skye.* | | |
| ,, ,, | ,, Payments for the Harbour Works at Broadford during the year ended this date, viz.:— | | |
| | Works, . . . . . . | £3610 0 0 | |
| | Engineer's fees, . . . . . | 200 0 0 | |
| | Inspector's wages, . . . . | 130 14 6 | |
| | | | 3940 14 6 |
| | *Coldingham Harbour, Berwickshire.* | | |
| ,, ,, | ,, Payments for the Harbour Works at Coldingham during the year ended this date, viz.:— | | |
| | Engineer's fees, . . . . . | 100 0 0 | |
| | | | 100 0 0 |
| | Carried over, | | £4310 11 11 |

## APPENDIX E.—No. III.—*continued.*

| | | | |
|---|---|---|---|
| Brought over | | | £16,217 17 9 |
| | | | £16,217 17 9 |

| | | | |
|---|---|---|---|
| | Brought over . | | £4310 11 11 |
| 1891. | *Auchmithie Harbour, Forfarshire.* | | |
| Dec. 31. By | Payments for the Harbour Works at Auchmithie during the year ended this date, viz.:— | | |
| | Works, . . . . . | £1360 0 0 | |
| | Engineer's fees, . . . . | 50 0 0 | |
| | Inspector's wages, . . . | 30 0 0 | |
| | | | 1440 0 0 |
| | *Balintore Harbour, Ross-shire.* | | |
| " " " | Payments for the Harbour Works at Balintore during the year ended this date, viz. :— | | |
| | Works, . . . . . | £2362 0 0 | |
| | Engineer's fees, . . . . | 100 0 0 | |
| | Inspector's wages, . . . | 135 19 6 | |
| | | | 2597 19 6 |
| | *Ness Harbour, Island of Lewis.* | | |
| " " " | Payments for the Harbour Works at Ness during the year ended this date, viz. :— | | |
| | Works, . . . . . | £1136 0 0 | |
| | Engineer's fees, . . . . | 100 0 0 | |
| | Inspector's wages, . . . | 144 7 6 | |
| | | | 1380 7 6 |
| " " " | Balance at this date, | | 6488 18 10 |
| | | | £16,217 17 9 |

## APPENDIX E.—No. IV.

**TELEGRAPHIC EXTENSION.—ACCOUNT of RECEIPT and EXPENDITURE by the Fishery Board for Scotland, for TELEGRAPHIC EXTENSION to Remote Fishery Districts in Scotland in the year 1891.**

*Dr.*

| Date | Particulars | £ | s. | d. |
|---|---|---|---|---|
| 1891. | | | | |
| Mar. 31. | To Appropriation from Surplus Herring Brand Fees, 1889, | £1,500 | 0 | 0 |
| | *St Mary's (Holm), Burray, and St Margaret's Hope, Orkney.* | | | |
| Aug. 24. | To Guarantee received from Mr John Laughton, Blanster, St Margaret's Hope, to meet his proportion of the deficit in receipts from inland messages forwarded, during the year ended 3rd August 1891, from the telegraph offices established at St Mary's, Burray, and St Margaret's Hope . . . . . | 69 | 19 | 3 |
| | Carried over | £1,569 | 19 | 3 |

*Cr.*

| Date | Particulars | £ | s. | d. |
|---|---|---|---|---|
| 1890. | | | | |
| Dec. 31. | By Balance, . . . . . . . | £489 | 10 | |
| 1891. | *Garrabost, Ross-shire.* | | | |
| June 22. | By Guarantee paid to H.M. Postmaster General to meet the deficit in receipts from inland messages forwarded, during the year ended 11th June 1891, from the telegraph office established at Garrabost, . . | 5 | 12 | 3 |
| | *Barvas, Ross-shire.* | | | |
| „ „ | „ Guarantee paid to H.M. Postmaster General to meet the deficit in receipts from inland messages forwarded, during the year ended 11th June 1891, from the telegraph office established at Barvas, . . | 14 | 9 | 2 |
| | *St Mary's (Holm), Burray, and St Margaret's Hope, Orkney.* | | | |
| Aug. 24. | By Guarantee paid to H.M. Postmaster General to meet the deficit in receipts from inland messages forwarded, during the year ended 3rd August 1891, from the telegraph offices established at St Mary's (Holm), Burray, and St Margaret's Hope, . . . | 209 | 17 | 8 |
| | *Achiltibuie, Ross-shire.* | | | |
| „ 17. | „ Guarantee paid to H.M. Postmaster General to meet the deficit in receipts from inland messages forwarded, during the year ended 7th August 1891, from the telegraph office established at Achiltibuie, . . | 103 | 18 | 11 |
| | Carried over | £823 | 8 | 8 |

## APPENDIX E.—No. IV.—*continued.*

| Date | | £ | s. | d. |
|---|---|---|---|---|
| | Brought over | £1,559 | 19 | 3 |
| 1891. | *Castlebay, Barra.* | | | |
| Oct. 20. | To Guarantee received from Lady Gordon Cathcart to meet her proportion of the deficit in receipts from inland messages forwarded, during the year ended 30th September 1891, from the telegraph office established at Castlebay, . . . . . . . | 118 | 3 | 9 |
| | Brought down | £1,678 | 3 | |

| Date | | £ | s. | d. |
|---|---|---|---|---|
| | Brought over | £823 | 8 | 8 |
| 1891. | *Brae, North Roe, and Ollaberry, Shetland.* | | | |
| Sept. 15. | By Guarantee paid to H.M. Postmaster General to meet the deficit in receipts from inland messages forwarded, during the year ended 27th August 1891, from the telegraph offices established at Brae, North Roe, and Ollaberry, . . . . . . | 72 | 12 | 11 |
| | *Coll and Tiree, Argyllshire.* | | | |
| " " | " Guarantee paid to H.M. Postmaster General to meet the deficit in receipts from inland messages forwarded, during the year ended 28th August 1891, from the telegraph offices established at Coll and Tiree, . . . . . . . . | 452 | 3 | 4 |
| | *Hillswick, Shetland.* | | | |
| " " | " Guarantee paid to H.M. Postmaster General to meet the deficit in receipts from inland messages forwarded, during the year ended 28th August 1891, from the telegraph office established at Hillswick, . | 81 | 4 | 2 |
| | *Durness, Sutherlandshire.* | | | |
| " " | " Guarantee paid to H.M. Postmaster General to meet the deficit in receipts from inland messages forwarded, during the year ended 28th August 1891, from the telegraph office established at Durness, . | 217 | 15 | 7 |
| | *Walls and Reawick, Shetland.* | | | |
| " 22. | " Guarantee paid to H.M. Postmaster General to meet the deficit in receipts from inland messages forwarded, during the year ended 9th September 1891, from the telegraph offices established at Walls and Reawick, . . . . . . | 173 | 1 | 5 |
| | Brought down | £1,820 | 6 | 1 |

| Date | | Particulars | £ | s. | d. |
|---|---|---|---|---|---|
| | | Brought over | £1,688 | 3 | 0 |
| 1891. | | *Ness, Lewis.* | | | |
| Oct. 30. | To | Guarantee received from Committee of Lloyds to meet their proportion of the deficit in receipts from inland messages forwarded, during the year ended 2nd October 1891, from the telegraph office established at Ness, . . . . . . . | 20 | 0 | 0 |
| Dec. 31. | To | Balance at this date, . . . . . . | 1,293 | 7 | 0 |
| | | | £3,001 | 10 | 0 |

| Date | | Particulars | £ | s. | d. |
|---|---|---|---|---|---|
| | | Brought over | £1,820 | 6 | 1 |
| 1891. | | *Castlebay, Barra.* | | | |
| Oct. 9. | By | Guarantee paid to H.M. Postmaster General to meet the deficit in receipts from inland messages forwarded, during the year ended 30th September 1891, from the telegraph office established at Castlebay, . . | 652 | 16 | 4 |
| | | *Portnaguran and Gress, Lewis.* | | | |
| „ 13. | „ | Guarantee paid to H.M. Postmaster General to meet the deficit in receipts from inland messages forwarded, during the year ended 2nd October 1891, from the telegraph offices established at Portnaguran and Gress, . . . . . . . . | 134 | 7 | 5 |
| | | *Ness, Lewis.* | | | |
| „ 16. | „ | Guarantee paid to H.M. Postmaster General to meet the deficit in receipts from inland messages forwarded, during the year ended 2nd October 1891, from the telegraph office established at Ness, . . . | 200 | 0 | 7 |
| | | *Arisaig, Inverness-shire.* | | | |
| Nov. 21. | „ | Guarantee paid to H.M. Postmaster General to meet the deficit in receipts from inland messages forwarded, during the year ended 13th November 1891, from the telegraph office established at Arisaig, . . | 193 | 19 | 7 |
| | | | £3,001 | 10 | 0 |

Fishery Board for Scotland,
Edinburgh, 21st December 1891.

## APPENDIX E.—No. V.

STATEMENT of GUARANTEES and EXPENDITURE in aid of TELEGRAPHIC EXTENSION from 1885 to 31st December 1891.

| Name of each Station to which Telegraphic Communication under this provision extended. | Guarantees. | | Expended annually by Board. | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Total Annual Guarantee. | Fishery Board Guarantee. | 1885. | 1886. | 1887. | 1888. | 1889. | 1890. | 1891. | Total. |
| | £ | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. |
| St Mary's (Holm) Burray, and St Margaret's Hope, Orkney, | † *281 | *187 6 8 | 141 19 0 | 141 9 11 | 146 16 9 | 146 7 8 | 139 4 1 | 142 17 10 | 139 18 5 | 999 3 8 |
| Castlebay, Barra, | † *858 | †*702 13 4 | 396 13 4 | 396 13 4 | 396 13 4 | 507 2 11 | 526 11 9 | 514 13 11 | 534 12 7 | 3,273 1 2 |
| Walls and Reawick, Shetland, | † *255 | *170 0 0 | 163 1 3 | 165 1 5 | 181 2 2 | 171 6 4 | 145 15 10 | 161 6 7 | 173 1 5 | 1,160 15 0 |
| Lochbuie, Mull, | † 66 | † 33 0 0 | ... | ... | ... | ... | 16 2 4 | 16 8 10 | ... | 32 11 2 |
| Hillswick, Shetland, | † 141 | † 94 0 0 | ... | ... | ... | ... | 55 8 5 | 75 7 4 | 81 4 2 | 211 19 11 |
| Brae, Ollaberry, and North Roe, Shetland, | † 133 | † 88 0 0 | ... | ... | ... | ... | 51 13 9 | 69 10 7 | 72 12 11 | 193 17 3 |
| Achiltibuie, Ross, | 123 | 123 0 0 | ... | ... | ... | ... | 105 19 10 | 102 0 9 | 103 18 11 | 311 19 6 |
| Arisaig, Inverness, | 251 | 251 0 0 | ... | ... | ... | ... | 188 6 5 | 185 10 11 | 193 19 7 | 567 16 11 |
| Portnaguran and Gress, Lewis, | 161 | 161 0 0 | ... | ... | ... | ... | 135 15 10 | 132 9 8 | 134 7 5 | 402 12 11 |
| Coll and Tiree, Argyll, | 531 | 531 0 0 | ... | ... | ... | ... | 458 7 7 | 451 12 6 | 452 3 4 | 1,362 3 5 |
| Durness, Sutherland, | 255 | 255 0 0 | ... | ... | ... | ... | 220 10 4 | 216 3 11 | 217 15 7 | 654 9 10 |
| Lochranza and Pirnmill, Bute, | † 106 | † 68 0 0 | ... | ... | ... | ... | 19 19 10 | ... | ... | 10 19 10 |
| Ness, Lewis, | † 236 | †218 0 0 | ... | ... | ... | ... | 197 5 9 | 189 3 7 | 180 0 7 | 566 9 11 |
| Barvas, Lewis, | 28 | 28 0 0 | ... | ... | ... | ... | ... | 17 10 5 | 14 9 2 | 31 19 7 |
| Garrabost, Lewis, | 18 | 18 0 0 | ... | ... | ... | ... | ... | 7 14 8 | 5 12 3 | 13 6 11 |
| | 3443 0 0 | 2928 0 0 | 701 13 7 | 703 4 8 | 724 12 3 | 824 16 11 | 2252 11 9 | 2,252 11 6 | 2,303 16 4 | 9,793 7 0 |

* Agreements expired, and question of renewal under consideration.

† Jointly with others.

## APPENDIX F.—No. I.

**LOANS TO FISHERMEN.—STATEMENT** showing the NUMBER of LOANS CARRIED OUT in each Crofting Fishery District, the AMOUNT PAID OVER, and the TOTAL INSTALMENTS RECEIVED (inclusive of interest) from the date when the Crofters Holdings (Scotland) Act, 1886, came into operation, to 31st December 1891, together with the NUMBER of LOANS and AMOUNT of INSTALMENTS in ARREAR.

| DISTRICTS. | Total No. of Loans carried out. | Amount advanced as Loans, | | | Total Instalments, including interest, received up to 31st Dec. 1891. | Arrears. | |
|---|---|---|---|---|---|---|---|
| | | To 31st Dec. 1889. | To 31st Dec. 1890. | To 31st Dce. 1891. | | No. of Loans. | Amount. |
| | | £ s. d. | £ s. d. | £ s. d. | £ s. d. | | £ s. d. |
| Cromarty, . | 2 | 303 10 0 | 303 10 0 | 303 10 0 | 104 15 10 | 1 | 17 14 10 |
| Helmsdale, . | 9 | 1,269 0 0 | 1,519 0 0 | 1,519 0 0 | 355 4 9 | 9 | 301 0 1 |
| Lybster, . . | 7 | 907 0 0 | 967 0 0 | 967 0 0 | 479 12 8 | 6 | 208 4 7 |
| Wick, . . | 72 | 7,096 1 6 | 9,852 1 6 | 9,852 1 6 | 3,818 4 8 | 52 | 1,769 8 1 |
| Orkney, . . | 6 | 635 0 0 | 635 0 0 | 635 0 0 | 320 3 2 | ... | ... |
| Shetland, . | 20 | 1,816 18 0 | 1,861 18 0 | 1,861 18 0 | 861 7 10 | 9 | 354 16 3 |
| Stornoway, . | 101 | 6,526 11 9 | 11,615 11 9 | 12,283 11 9 | 3,271 15 1 | 70 | 1,780 1 5 |
| Barra, . . | 20 | 1,604 16 4 | 1,888 6 4 | 1,888 6 4 | 827 14 1 | 10 | 366 11 8 |
| Loch Broom, . | 8 | 767 9 0 | 767 9 0 | 767 9 0 | 229 4 6 | 7 | 358 2 9 |
| Fort William, . | 1 | ... | 34 0 0 | 34 0 0 | 14 6 3 | ... | ... |
| Totals, . | 246* | 20,926 6 7 | 29,443 16 7 | 30,111 16 7 | 10,282 8 10 | 164 | 5,155 19 8 |

* In four cases of loans the boats mortgaged in security were seized by the Board for non-payment of arrears and sold to other crews, the price being paid partly in cash and partly by fresh mortgages.

## APPENDIX F.—No. II.

RETURN of ARREARS of LOANS granted on security of Boats, mortgaged to the Board, deemed to constitute Bad Debts, as at 31st December last, to write off the Principal of which, against the Local Loans Fund, the authority of Parliament is required by Section 15 (2) of the National Debt and Local Loans Act, 1887 (50 Vict. cap. 16). The Return does not include Arrears of Interest due.

| Fishery Districts in which Loans were made. | Number of Borrowers in each case. | Dates when Loans were granted. | Amounts of Loans. | Amounts Repaid by Borrowers. | Expenses Incurred in Prosecutions, Seizures, or Sales. | Dates when Boats were Abandoned, Surrendered, Seized, or Wrecked. | Dates when Boats were Sold. | Amounts realised by Sales or recovered from Insurance Company. | Net Proceeds of Sales Credited to Borrowers' Accounts. | Outstanding Balances, Exclusive of Interest, Considered Irrecoverable. | Grounds on which Arrears of Loans are deemed to constitute Bad Debts. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1888 | £ s. d. | £ s. d. | £ s. d. | 1890 | 1890 | £ s. d. | £ s. d. | £ s. d. | |
| Wick, . . | one | April | 120 0 0 | 22 10 0 | 4 2 9 | September | November | 60 0 0 | 55 17 3 | 41 12 9 | Boat which was only security for loan, given up, as owner's health broke down. |
| Helmsdale, . . | two | May | 90 0 0 | 9 0 0 | ... | April | May | 18 0 0 | 18 0 0 | 63 0 0 | Boat thrown on rocks and seriously damaged; owners unable and unwilling to repair her, or pay instalments. |
| Wick, . . | ,, | ,, | 265 0 0 | 21 11 3 | 9 11 1 | November | December | 105 0 0 | 95 8 1 | 147 19 10 | Boat seized, as borrowers would pay no more. |
| Shetland, . . | four | ,, | 110 0 0 | 18 6 8 | ... | May | June | 60 0 0 | 60 0 0 | 31 13 4 | Boat given up by borrowers who abandoned hope of paying any further instalments. |
| Loch Broom, . | five | ,, | 130 0 0 | 9 3 2 | 9 4 6 | 1889 December | December | 15 0 0 | 5 15 6 | 115 1 4 | Boat seized, as owners who had quarrelled among themselves, refused to pay, and left the boat uncared for. |

APPENDIX F. No. II.—*continued.*

| Fishery Districts in which Loans were made. | Number of Borrowers in each case. | Dates when Loans were granted. | Amounts of Loans. | Amounts Repaid by Borrowers. | Expenses Incurred in Prosecutions, Seizures, or Sales. | Dates when Boats were Abandoned, Surrendered, Seized, or Wrecked. | Dates when Boats were Sold. | Amounts realised by Sales or recovered from Insurance Company. | Net Proceeds of Sales Credited to Borrowers' Accounts. | Outstanding Balances, Exclusive of Interest, Considered Irrecoverable. | Grounds on which Arrears of Loans are deemed to constitute Bad Debts. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1888 | £ s. d. | £ s. d. | £ s. d. | 1891 | 1891 | £ s. d. | £ s. d. | £ s. d. | |
| Stornoway, . . | seven | June | 36 0 0 | 4 10 0 | 5 1 0 | February | February | 10 0 0 | 4 19 0 | 26 11 0 | Boat seized, as borrowers would pay no more. |
| Wick, . . . | two | July | 140 0 0 | 16 15 0 | 8 8 3 | 1889 December | 1890 December | 65 0 0 | 56 11 9 | 66 13 3 | Boat given up by borrowers who abandoned hope of paying any further instalments. |
| Do. . . . | ,, | ,, | 95 0 0 | ... | 12 5 0 | November | April | 50 0 0 | 37 15 0 | 57 5 0 | Do. do. |
| Loch Broom, . | four | Aug. | 118 0 0 | 22 3 8 | 1 5 10 | 1891 January | 1891 February | 20 0 0 | 18 14 2 | 77 2 2 | Do. do. |
| Stornoway, . . | six | Oct. | 31 0 0 | ... | 1 9 11 (expenses of survey) | 1889 March | ... | 30 0 0 | 28 10 1 | 2 9 11 | Boat totally wrecked and owners all drowned: boat insured to full amount insurable. |
| Do. . . | five | Nov. | 51 0 0 | ... | 5 2 5 | 1890 January | 1890 October | 30 0 0 | 24 17 7 | 26 2 5 | Boat given up by borrowers, as they found themselves unable to fulfil their obligations to the Board. |
| Do. . . | six | Dec. | 144 0 0 | ... | 20 19 3 | February | 1891 January | 125 0 0 | 104 0 9 | 39 19 3 | Do. do. |
| Barra, . . | four | 1889 April | 140 0 0 | ... | 2 8 0 | June | 1890 November | 60 0 0 | 57 12 0 | 82 8 0 | Boat abandoned by borrowers, most of whom left the country. |

APPENDIX F. No. II.—*continued.*

| Fishery Districts in which Loans were made. | Number of Borrowers in each case. | Dates when Loans were granted. | Amounts of Loans. | Amounts Repaid by Borrowers. | Expenses Incurred in Prosecutions, Seizures, or Sales. | Dates when Boats were Abandoned, Surrendered, Seized, or Wrecked. | Dates when Boats were Sold. | Amounts realised by Sales or recovered from Insurance Company. | Net Proceeds of Sales Credited to Borrowers' Accounts. | Outstanding Balances, Exclusive of Interest, Considered Irrecoverable. | Grounds on which Arrears of Loans are deemed to constitute Bad Debts. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1889 | £ s. d. | £ s. d. | £ s. d. | 1890 | 1890 | £ s. d. | £ s. d. | £ s. d. | |
| Wick, . . | four | April | 257 0 0 | 15 0 0 | 10 2 4 | November | December | 120 0 0 | 109 17 0 | 132 2 4 | Boat seized, as borrowers had no prospects of being able to make further payments. |
| Lybster, . . | one | May | 112 0 0 | 8 0 0 | 1 4 3 | December | ,, | 65 0 0 | 63 15 9 | 40 4 3 | Do. do. |
| Wick, . . . | two | ,, | 107 0 0 | 7 12 11 | 3 8 5 | ,, | ,, | 52 0 0 | 48 11 7 | 50 15 6 | Boat given up by borrowers. |
| Stornoway, . . | six | ,, | 208 0 0 | ... | 1 3 6 | 1891 March | 1891 March | 80 0 0 | 78 16 6 | 129 3 6 | Boat seized, as borrowers would pay no more. |
| Wick, . . . | one | June | 100 0 0 | 16 13 4 | 1 3 11 | 1890 December | 1890 December | 58 0 0 | 56 16 1 | 26 10 7 | Boat given up by borrowers. |
| Do. . . . | three | 1890 Jan. | 220 0 0 | ... | ... | 1891 January | 1891 February | 90 0 0 | 90 0 0 | 130 0 0 | Do. do. |
| Do. . . . | ,, | 1888 April | 90 0 0 | 18 17 2 | 2 11 2 | March | March | 56 0 0 | 53 8 0 | 17 14 0 | Boat abandoned by borrowers. |
| Stornoway, . . | six | May | 40 10 0 | 5 1 4 | 1 5 5 | 1890 December | November | 6 0 0 | 4 14 7 | 30 14 1 | Boat seized, as borrowers would pay no more. |
| Shetland, . . | two | ,, | 140 0 0 | 10 0 0 | 2 0 0 | 1891 September | September | 62 0 0 | 60 0 0 | 70 0 0 | Boat given up by borrowers, as they found themselves unable to fulfil their obligations to the Board. |

# APPENDIX F. No. II.—*continued.*

| Fishery Districts in which Loans were made. | Number of Borrowers in each case. | Dates when Loans were granted. | Amounts of Loans. | Amounts Repaid by Borrowers. | Expenses Incurred in Prosecutions, Seizures, or Sales. | Dates when Boats were Abandoned, Surrendered, Seized, or Wrecked. | Dates when Boats were Sold. | Amounts realised by Sales or recovered from Insurance Company. | Net Proceeds of Sales Credited to Borrowers' Accounts. | Outstanding Balances Exclusive of Interest, Considered Irrecoverable. | Grounds on which Arrears of Loans are deemed to constitute Bad Debts. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1888 | £ s. d. | £ s. d. | £ s. d. | 1891 | 1891 | £ s. d. | £ s. d. | £ s. d. | |
| Lybster, . . | one | May | 312 0 0 | 41 4 0 | 0 19 8 | March | March | 158 0 0 | 157 0 4 | 113 15 8 | Boat given up by borrowers, as they found themselves unable to fulfil their obligations to the Board. |
| Wick, . . . | two | ,, | 95 0 0 | 11 17 6 | 1 5 2 | ,, | April | 60 0 0 | 58 14 10 | 24 7 8 | Do. do. |
| Do. . . . | three | ,, | 125 0 0 | 23 8 9 | 2 12 11 | December | December | 102 0 0 | 99 7 1 | 2 4 0 | Do. do. |
| Barra, . . | four | ,, | 263 0 0 | 15 5 8 | 3 11 6 | 1890 December | April | 100 0 0 | 96 8 6 | 151 5 10 | Boat seized, as borrowers would pay no more. |
| Stornoway, . | seven | ,, | 167 11 9 | 10 9 6 | 9 18 6 | June | ,, | 60 0 0 | 50 1 6 | 107 0 9 | Do. do. |
| Loch Broom, . | five | ,, | 30 0 0 | 15 0 0 | 1 9 11 | 1891 January | ,, | 6 0 0 | 4 10 1 | 10 9 11 | Do. do. |
| Stornoway, . . | four | April | 80 0 0 | 26 13 4 | 36 1 2 | October | October | 45 0 0 | 8 18 10 | 44 7 10 | Boat partially wrecked and abandoned by borrowers; Board having to pay share of cost of repairing boat before selling her. |
| Loch Broom, . | two | June | 40 0 0 | 4 0 0 | 1 9 10 | January | April | 5 0 0 | 3 10 2 | 32 9 10 | Boat seized, as borrowers would pay no more. |
| Do. . | five | ,, | 77 0 0 | 18 11 2 | 1 6 6 | June | August | 36 0 0 | 34 13 6 | 23 15 4 | Do. do. |
| Stornoway, . . | two | 1889 Feb. | 32 0 0 | 4 0 0 | 3 9 4 | July | , | 10 0 0 | 6 10 8 | 21 9 4 | Boat abandoned by borrowers. |

APPENDIX F. No. II.—*continued.*

| Fishery Districts in which Loans were made. | Number of Borrowers in each case. | Dates when Loans were granted. | Amounts of Loans. | Amounts Repaid by Borrowers. | Expenses Incurred in Prosecutions, Seizures, or Sales. | Dates when Boats were Abandoned, Surrendered, Seized, or Wrecked. | Dates when Boats were Sold. | Amounts realised by Sales or recovered from Insurance Company. | Net Proceeds of Sales Credited to Borrowers' Accounts. | Outstanding Balances, Exclusive of Interest, Considered Irrecoverable. | Grounds on which Arrears of Loans are deemed to constitute Bad Debts. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1889 | £ s. d. | £ s. d. | £ s. d. | 1891 | 1891 | £ s. d. | £ s. d. | £ s. d. | |
| Stornoway, | four | Feb. | 45 0 0 | 17 4 10 | ... | October | August | ... | ... | 27 15 2 | Boat totally wrecked, and crew had failed to insure her. |
| Do. | six | March | 199 0 0 | 9 19 0 | 23 17 2 | March | June | 60 0 0 | 36 2 10 | 152 18 2 | Boat seized, as borrowers would pay no more. Board employed gunboat in seizing. |
| Do. | three | April | 21 0 0 | ... | 1 5 10 | November | November | 8 0 0 | 6 14 2 | 14 5 10 | Boat abandoned by borrowers. |
| Do. | five | „ | 94 0 0 | 9 13 8 | 5 3 6 | „ | „ | 35 0 0 | 28 16 6 | 55 9 10 | Boat seized, as borrowers would pay no more. |
| Shetland, | one | May | 90 0 0 | 9 0 0 | 2 18 8 | January | April | 48 0 0 | 45 1 4 | 35 18 8 | Boat given up by borrower, as he found himself unable to meet his obligations to the Board. |
| Stornoway, | eight | October | 28 0 0 | 5 10 0 | ... | April | „ | 20 0 7 | 20 0 7 | 2 9 5 | Boat wrecked, but, as borrowers were heavily in arrear, amount received from Insurance Company insufficient to cover loss. |
| Wick, | five | 1890 May | 274 0 0 | ... | 5 11 1 | October | November | 182 0 0 | 176 8 11 | 97 11 1 | Boat given up by borrowers as they found themselves unable to meet their obligations to the Board. |
| | | Totals, | 4717 1 9 | 427 1 11 | 204 17 9 | | | 2172 0 7 | 1067 2 10 | 2322 17 0 | |

# APPENDIX G.

REPORT BY ARCHIBALD YOUNG, Advocate, Inspector of Salmon Fisheries for Scotland, and Evidence in Application by Mrs Ogilvie of Barcaldine for an Order for a Several Oyster and Mussel Fishery in Loch Creran.

I have the honour to report that, as directed by the Fishery Board for Scotland, I held an Inquiry, on Tuesday the 17th November last, in the Station Hotel, Oban, into the application for a Several Oyster and Mussel Fishery in Loch Creran, *ex adverso* of her lands, promoted by Mrs Ogilvie of Barcaldine.

For the promoter there appeared Messrs Hosack and Sutherland, Solicitors, Oban; Mr Munro Campbell of Kinlochlaich, who has a property on the shores of Loch Creran opposite Barcaldine, was also present and his agent, Mr Maclaren, Solicitor, Oban; Colonel M'Dougall of Dunolly likewise attended as Tutor and Curator for Donald P. C. Campbell of Balliveolan, whose property marches with Barcaldine near the head of the Loch.

Messrs Hosack and Sutherland stated that the statutory requisites necessary in the case of such a fishery as that now applied for had been duly complied with, and the documents placed in the hands of the Fishery Board. They likewise handed in four letters (1) from Mr Maclaren as agent for Mr Campbell Munro; (2) from Mr Donald Beith, on behalf of the estate of Barcaldine Castle; (3) from Messrs J. B. Smith & Donald, W.S., Edinburgh, on behalf of the estate of Fasnacloich; and (4) letter from Colonel Macdougall as representing the laird of Balliveolan, who is a minor.

The following evidence was given for the promoter, Mrs Ogilvie:—

REV. JOHN SUTHERLAND.—I have resided at the Free Church Manse, Barcaldine, for 30 years, and always have taken an interest in the natural history of the district.

I am well acquainted with the shores of Loch Creran. For the first few years after I arrived at Barcaldine, oysters were plentiful all over, but especially so in certain places, for instance—at the boat-house, at Cregan Ferry, and also near the mouth of Culnaline Burn, and generally over the bed of the Loch below ordinary low-water mark, also at the point at Dalintober which is upon the adjoining property of Mr A. G. Cameron.

I believe that oysters are likewise to be found in considerable quantities upon the Appin shore of the Loch, and I know that they have been taken at different times by parties who collected oysters for selling.

Oysters are not now so plentiful as they were on my first acquaintance with the Loch.

The deterioration in my opinion was chiefly owing to the fact that a man, whose name I think was Blair, came here and dredged the oysters without restraint (and I think this happened over 20 years ago). The then proprietor of Barcaldine had no lease of the fishing, and was unable to stop Blair's depredations. The proprietor's agent took measures to prevent Blair but without success, and I believe the following year a lease was procured from the Crown, which has been renewed by the successive proprietors from that time. Since then I know that the oysters have been recuperating in some places. I am aware that Donald Clark at one tide collected, while in the service of Mr Rath-

bone, tenant of Barcaldine, as many as 1500 or thereabouts near the boat-house, and I have heard that a large quantity of very small oysters were thrown up on the beach near the same place during a very severe storm.

There has never been any strict preservation of shell-fish in Loch Creran, and owing to this, parties were in the habit of taking, either for their own use or for sale, oysters and other shell-fish as they might find them, and this continues up to the present time.

Along the shore and within the limits of the proposed Order at various places there are mussel-scalps, particularly between Culnaline Burn and the Taile River, also off Rhugarbh, and near and about the head of the Loch.

Several times within my recollection have East Coast fishing boats come into the Loch for mussels for bait.

Mr Campbell Ogilvie, with a view to improving the oyster fishing, employed a man to lay down tiles between the boat-house and the mouth of the River Taile, as an experiment to ascertain how they would stand the lash of the tide, and especially with a view of testing the adaptability of a scheme of his own of catching oyster spat.

In a general way I am acquainted with Mr Anderson Smith's operations in connection with his attempted oyster rearing. But as I understand that a letter from Mr Smith to Mr Young, on the subject of the shell-fishings in Loch Creran, is printed in a Report by Mr Young to the Fishery Board, on the Oyster and Mussel Fishings on the West Coast of Scotland from Loch Ryan to the Island of Mull, I cannot pretend to add anything to information which he is more competent to give; only I reckon it unfortunate that his work stopped at the point at which it did.

I am still hopeful that oyster rearing may succeed in Loch Creran if it will in any of our western lochs.

Knowing that Mrs Ogilvie means to make the attempt to rear oysters and to cultivate mussels on the most approved methods, and to protect them efficiently, I venture to hope the Fishery Board will afford her every facility for carrying out her intentions.

There are a good many dog-whelks and star-fish, but not in so great numbers as to interfere seriously with the cultivation of oysters, if ordinary means are taken to get rid of them.

Donald Clark made the following statement:—

Donald Clark, presently living at the smithy croft, Barcaldine:—I was born upon the estate and I have lived on the Loch side all my life, excepting a few years off and on when I was away at service.

I was in use to lift the oysters from the shore many years ago. I have mind of being home when Blair, about whom Mr Sutherland speaks, was in the Loch, but I never sold any oysters to him.

Ever since I remember there were plenty oysters in the Loch, but they got much scarcer after Blair was there. Carmichael the old gamekeeper and myself were going out sometimes in the boat for Mr Rathbone,* and we used to get plenty for the house as they were wanted.

At that time the best place was at the slate quarry, and the east side of the boat-house near the Taile. I, along with three ladies from the Barcaldine House, picked up 1500 on the shore in one tide. That was about 15 years ago.

I started work with Mr Anderson Smith, when he came here about 13 years ago, and it was I who showed him over the shore before he took the fishings.

We used to collect in a tide about 200 to 400 according to the weather and the tide, and alone I have got 300 many a time for him.

We used to take them up with the grape and pick them off the rocks and the shore.

There was a mussel-bed at Dalranach when I was a boy, but it has disappeared. The people used the bait.

The people about and from other places have always been taking oysters and they have never been much stopped.

* Mr Rathbone was then tenant of Barcaldine.

The following Minutes reserving all their rights, &c., were put in for Colonel Macdougall and Mr Campbell Munro.

MINUTE for CHARLES ALLAN M'DOUGALL, Esquire, of Macdougall and Dunollie, in the County of Argyll; REGINALD HOPE PARKINSON, Esquire, late Second Battalion South Staffordshire Regiment, residing at 3 Alexandra Terrace, Limerick; and Mrs CAROLINE GOODENOUGH or CAMPBELL, widow of the late Donald Campbell, Esquire, of Balliveolan, the Tutors and Curators of DONALD PATRICK COLIN CAMPBELL, of Balliveolan, nominated and appointed by the said Donald Campbell in his Trust-Disposition and Settlement, dated 11th February 1888, and recorded in the Books of Council and Session, 16th June 1891.

The Tutors and Curators of the said Donald Patrick Colin Campbell, of Balliveolan, in the County of Argyll, who is still in minority, with reference to the meeting held by Mr Young on behalf of the Fishery Board for Scotland of this date, to consider objections to the proposed Fishery Order sought by Mrs Ogilvie of Barcaldine, for the establishment and maintenance by her of a Several Oyster and Mussel Fishery in Loch Creran, when it was arranged that a Minute should be presented on behalf of the Laird of Balliveolan, asking the said Fishery Board for Scotland to consider and preserve the rights of the Balliveolan property in Loch Creran and the rivers, in order that there may be no encroachment thereon, and in view of the fact that the fishermen in the service of the said Mrs Ogilvie have lately been trespassing on the mussel-banks *ex adverso* of the lands of Balliveolan, and interfering with the fishing rights thereon of the tenants of the Balliveolan fishings, beg now to submit to the said Board the following objections on behalf of Balliveolan to the Order craved.

1. There has been an infringement of the fishing rights of Balliveolan, as was pointed out on the deposited plan showing the boundaries; and the proprietor of Balliveolan is entitled to have his right of fishing preserved to him, he having a duly completed feudal title thereto. The fishings of Balliveolan in Loch Creran extend from where the River Buie or Buidhe on the south east runs into the Loch to the place where at low-water the River Creran joins it on the north east, and include the mussel-bed in front of the mansion house of Balliveolan, over which Mrs Ogilvie's fishermen have lately been trespassing.

2. It is feared that any erections in connection with the proposed Oyster and Mussel fishery which might be situated in the narrows or narrow part of Loch Creran, between the outer or western part of the Loch, and the inner or eastern part, would be injurious to the rights of salmon-fishing which belong, *inter alios*, to the Laird of Balliveolan, such erections tending to scare fish when entering the upper reach of the Loch from the sea, or to retain them, and so prevent them from entering the other parts of the inner Loch, in which the Balliveolan fishings are.

The Tutors and Curators of the proprietor of Balliveolan therefore respectfully pray the Fishery Board for Scotland to make provision for the protection of the rights of property in the fishings in Loch Creran which belong to their ward.

MINUTE for DUNCAN HANDBY CAMPBELL MUNRO, Esquire, of Kinlochlaich, in the County of Argyll. In the application by Mrs MARGARET OGILVIE of Barcaldine, in the said County of Argyll, to the Honourable the Fishery Board of Scotland, for a Several Oyster and Mussel Fishery in Loch Creran in said County.

Whereas the said Duncan Handby Campbell Munro is proprietor of the Estates of Kinlochlaich and Creigan on the north shores of Loch Creran, and has by Crown Charter a right to the Oyster and Mussel Fisheries *ex adverso* of said lands of Kinlochlaich and Creigan.

And whereas the said Mrs Margaret Ogilvie is making application for a Several Oyster and Mussel Fishery on the opposite shore or south side of Loch Creran, the said Duncan Handby Campbell Munro craves that the Honourable

the Fishery Board of Scotland will, in granting the said Several Oyster and Mussel Fishery, not grant such rights as will interfere with, or affect his rights to the Oyster and Mussel fisheries *ex adverso* of his said lands of Kinlochlaich and Creigan.

Further, the said Duncan Handby Campbell Munro is desirous that the navigation of the Loch and the drift-herring fishery nets should not be interfered with, and he craves that the Fishery Board in making out the fishing of the Loch will not put the buoys in the deepest water of the Loch.

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It humbly seems to me that the evidence for the promoter given above, is amply sufficient to prove that Loch Creran is well adapted for Oyster and Mussel culture; that it formerly produced large quantities of these valuable molluscs; and that careful and judicious culture and efficient protection would, probably, in a few years, restore it to its former productiveness. Mrs Ogilvie is prepared to cultivate that part of the sea-bottom of Loch Creran to which the Order applies, according to the most improved modern methods, and to have it protected, by day and night if necessary, against illegal fishing. This she can well afford to do, and I venture to think, looking to all the circumstances of the case, that she should be allowed the opportunity of doing so, and that her application for a Several Oyster and Mussel Fishery should be granted.

I may, perhaps, be allowed to mention that, a short time ago, I inspected the Oyster and Mussel fisheries on the West Coast, from Loch Ryan northwards to the Island of Mull, and presented a Report to the Board which is dated 18th February 1888. In the course of that inspection, I visited and carefully examined Loch Creran, and I am perfectly satisfied of its capabilities for successful Oyster and Mussel culture, provided the poachers from Oban and the neighbourhood can be effectually kept at bay.

With reference to the Minutes put in regarding the properties of Balliveolan and Kinlochlaich by Colonel MacDougall and Mr Campbell Munro, it should be kept in view that the mere fact of Mrs Ogilvie's receiving the Order for a Several Fishery in Loch Creran *ex adverso* of her lands, will not give her the slightest right or title to interfere with, or infringe upon, the fisheries belonging to these properties which are held by Royal Grant or Charter; and trespass upon fisheries so held may be resisted as readily and effectually after the grant as before it. Then, as to what is said in the Minute for Mr Campbell Munro about the buoys marking out the limits of the fishery being an impediment to the navigation of the Loch, it is only necessary to remark that, whenever it can be shown that they form a serious obstruction to the navigation of the Loch, they may be put down in spite of the Several Order. Of this there can be no doubt whatever, as the following quotation from Professor Bell's Commentaries on the Law of Scotland is sufficient to show:—

Navigation and fishing are the great public uses, to which the other rights are subservient. *Navigation* is a use for the public, primary and inalienable; not to be interrupted or encroached on by grant of ferry, or by exercise of any ancient right of ferry. And those sailing in the course of the ferry cannot be stopped or impeded of their right of free navigation, unless it be shown that they are encroaching on the proper right of passage from shore to shore.

*Fishing* is a secondary use; but it is not inalienable, like that of navigation. So the right of sea-fishing for salmon may be given, either expressly by a grant of the fishing of salmon, or by a clause, *cum piscationibus*, followed by possession of salmon fishing. The grant of salmon fishing in the sea is the only monopoly of sea-fishing which has always been admitted.

To the same effect Mr Stewart writes in his Treatise on the Law of Scotland relating to Rights of Fishing:—

'The right of fishing,' he says, 'is always subservient to the superior right 'of navigation.'

Colonel MacDougall, in his Minute, expresses a fear that the marking out of the limits of the Several Fishery applied for by Mrs Ogilvie may interfere with the Salmon Fishings belonging to the property of Balliveolan by scaring ascending salmon, and he wishes the Board to make such arrangements as will prevent this. I scarcely think that the Board, in the present Inquiry, can go into questions of conflicting rights of Salmon Fishings—if such there be—between Barcaldine and Balliveolan. But, at the same time, I cannot see that the marking out of the Several Fishery is likely to have the effect indicated by Colonel MacDougall; and a glance at the map will show that it is not at all probable that Mrs Ogilvie, whose Salmon Fishings are immediately below those of Balliveolan, would mark out her Several Fishery in such a way as to scare away and drive back ascending salmon, as that would be to injure her own Salmon Fisheries as well as those of Balliveolan. It is clearly not her interest to do so.

Sometime after the Inquiry had closed, I received, on Tuesday evening, at Oban, two letters from crofters on the Barcaldine estate, protesting against their rights of fishing and gathering sea-weed for manure on the shores of Loch Creran being interfered with. With reference to these letters, I may state that the right of fishing referred to can only be a right of fishing for white fish, which will not be interfered with by the Several Order; and I may also mention that I am informed, on good authority, that there is not the slightest intention to prevent the gathering of sea-weed by the crofters, to be used as manure.

I have the honour to be,

Your obedient Servant,

ARCH$^{D}$. YOUNG.

THE FISHERY BOARD FOR SCOTLAND,
EDINBURGH, 20*th November* 1891.

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TENTH

# ANNUAL REPORT

OF THE

# FISHERY BOARD FOR SCOTLAND,

**Being for the Year 1891.**

*IN TWO PARTS.*

PART I.—GENERAL REPORT.
PART II.—REPORT ON SALMON FISHERIES.

---

## PART I.—GENERAL REPORT.

Presented to both Houses of Parliament in pursuance of
Act 45 and 46 Vict. cap. 78.

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# APPENDIX.



* A full Table of Contents will be found prefixed to this Report, pages 3–4.

# TENTH ANNUAL REPORT.

TO THE MOST HONOURABLE

THE MARQUESS OF LOTHIAN, K.T.,

*Her Majesty's Secretary for Scotland.*

OFFICE OF THE FISHERY BOARD
FOR SCOTLAND,
EDINBURGH, *3rd May* 1892.

MY LORD,

In continuation of our Tenth Annual Report, we have the honour to submit—

## PART II.—REPORT ON SALMON FISHERIES.

The year 1891 was a favourable year both for netting and angling. For angling especially, it was particularly good throughout Scotland, not only as regards number but also size of fish. A reference to the Report by the Inspector of Salmon Fisheries will be sufficient to show this. 1891 a favourable season both for nets and rods.

In the following Table will be found a return of the number of boxes of Scotch salmon sent to Billingsgate Market from 1834 to 1891, both years inclusive. It will be observed that 6958 more boxes of salmon were sent to Billingsgate in 1891 than in 1890. Number of boxes of Scotch salmon sent to Billingsgate in 1891. Estimating the value of the salmon sent to Billingsgate from Scotland during 1891 at £5, 10s. per box, we find the total amount to be £138,389; and if as much is added—a very moderate estimate—for the salmon consumed at home and sent to other Estimated value of Scotch Salmon in 1891.

markets than London, we arrive at a total sum of £276,778 as the value of the Scottish salmon in 1891.

| Year. | Boxes of Scotch Salmon. | Year. | Boxes of Scotch Salmon. |
|---|---|---|---|
| 1834 | 30,650 | 1863 | 24,297 |
| 1835 | 42,330 | 1864 | 22,603 |
| 1836 | 24,570 | 1865 | 19,009 |
| 1837 | 32,300 | 1866 | 21,725 |
| 1838 | 21,400 | 1867 | 23,006 |
| 1839 | 16,340 | 1868 | 28,020 |
| 1840 | 15,160 | 1869 | 20,474 |
| 1841 | 28,500 | 1870 | 20,648 |
| 1842 | 39,417 | 1871 | 23,390 |
| 1843 | 30,300 | 1872 | 24,404 |
| 1844 | 28,178 | 1873 | 30,181 |
| 1845 | 31,062 | 1874 | 32,180 |
| 1846 | 25,510 | 1875 | 20,375 |
| 1847 | 20,112 | 1876 | 34,655 |
| 1848 | 22,525 | 1877 | 28,189 |
| 1849 | 23,690 | 1878 | 26,465 |
| 1850 | 13,940 | 1879 | 13,929 |
| 1851 | 11,593 | 1880 | 17,457 |
| 1852 | 13,044 | 1881 | 23,905 |
| 1853 | 19,485 | 1882 | 22,968 |
| 1854 | 23,194 | 1883 | 35,506 |
| 1855 | 18,197 | 1884 | 27,219 |
| 1856 | 15,438 | 1885 | 30,362 |
| 1857 | 18,654 | 1886 | 23,407 |
| 1858 | 21,564 | 1887 | 26,907 |
| 1859 | 15,823 | 1888 | 22,857 |
| 1860 | 15,870 | 1889 | 21,101 |
| 1861 | 12,337 | 1890 | 18,931 |
| 1862 | 22,796 | 1891 | 25,889 |

More than three-fourths of the salmon sent to Billingsgate in 1891 were sent in June, July, and August, no fewer than 19,179 boxes being sent in these months. The greatest number were forwarded in July, when 8067 boxes were sent.

Alteration in the annual close-time of the Tay.

The alteration in the annual close-time applicable to the Tay has proved a great success. It now extends from 27th August to 10th February, with extension of time for rod fishing from 15th January to 10th February, and from 27th August to 15th October. During the early fishing, before the nets are on, a number of fish have been killed, both in Loch Tay and in the river; so that the upper proprietors get some compensation for the heavy and continuous netting below Perth, which, after the 10th February, intercepts the great majority of the fish. The Clerks to the Tay District Board, in their answers to the printed queries issued by the Inspector, write as follows about the present close-time:—'The 'present annual close-time is as good as it can be under the existing Act, since it has been changed to 26th August and 11th 'February, but the latter is too late for commencement. The rod-'fishing which now begins on 15th January will certainly be a 'great boon to anglers and the proprietors of upper fishings.'

Rental of the Tay since 1828.

The following is the rental of the Tay fishings from 1828, the date of Home-Drummond's Act, till 1891:—

| Year. | Rental. | | | Year. | Rental. | | |
|---|---|---|---|---|---|---|---|
| 1828 | £14,574 | 10 | 0 | 1860 | £13,827 | 10 | 7 |
| 1829 | 14,529 | 10 | 0 | 1861 | 14,009 | 15 | 7 |
| 1830 | 13,747 | 8 | 0 | 1862 | 14,080 | 12 | 0 |
| 1831 | 13,874 | 0 | 0 | 1863 | 14,232 | 16 | 6 |
| 1832 | 11,629 | 0 | 0 | 1864 | 16,742 | 5 | 2 |
| 1833 | 11,577 | 0 | 0 | 1865 | 17,618 | 0 | 7 |
| 1834 | 10,907 | 10 | 0 | 1866 | 17,465 | 3 | 4 |
| 1835 | 10,856 | 10 | 0 | 1867 | 16,852 | 18 | 4 |
| 1836 | 10,211 | 10 | 0 | 1868 | 16,965 | 15 | 10 |
| 1837 | 10,150 | 6 | 0 | 1869 | 17,444 | 15 | 0 |
| 1838 | 10,285 | 0 | 0 | 1870 | 17,044 | 8 | 4 |
| 1839 | 10,498 | 0 | 0 | 1871 | 16,382 | 8 | 4 |
| 1840 | 11,058 | 0 | 0 | 1872 | 15,162 | 15 | 0 |
| 1841 | 10,846 | 5 | 0 | 1873 | 17,519 | 14 | 0 |
| 1842 | 10,235 | 15 | 0 | 1874 | 18,941 | 13 | 8 |
| 1843 | 10,512 | 5 | 0 | 1875 | 21,634 | 4 | 4 |
| 1844 | 10,386 | 10 | 0 | 1876 | 19,930 | 18 | 4 |
| 1845 | 10,751 | 15 | 0 | 1877 | 21,126 | 14 | 0 |
| 1846 | 10,099 | 15 | 0 | 1878 | 21,187 | 1 | 0 |
| 1847 | 11,421 | 10 | 0 | 1879 | 21,697 | 14 | 0 |
| 1848 | 12,057 | 10 | 0 | 1880 | 22,518 | 8 | 7 |
| 1849 | 10,729 | 16 | 0 | 1881 | 19,579 | 11 | 5 |
| 1850 | 9,491 | 11 | 0 | 1882 | 19,221 | 11 | 7 |
| 1851 | 9,530 | 0 | 0 | 1883 | 17,773 | 3 | 0 |
| 1852 | 7,973 | 5 | 0 | 1884 | 19,655 | 14 | 5 |
| 1853 | 8,715 | 17 | 6 | 1885 | 20,417 | 0 | 2 |
| 1854 | 9,269 | 6 | 5 | 1886 | 22,542 | 2 | 8 |
| 1855 | 9,977 | 13 | 5 | 1887 | 22,143 | 16 | 7 |
| 1856 | 10,199 | 10 | 4 | 1888 | 19,655 | 0 | 0 |
| 1857 | 10,772 | 0 | 5 | 1889 | 17,731 | 2 | 0 |
| 1858 | 11,487 | 2 | 5 | 1890 | 17,819 | 10 | 0 |
| 1859 | 11,884 | 14 | 0 | 1891 | 17,237 | 6 | 8 |

It will be observed from the above statement of the rental of the Tay, that, from the time when the netting season was extended to the 15th September by the Act of 1828, the produce of the river went on decreasing until in 1852 it had fallen to its lowest point, £7973, 5s. The proprietors then voluntarily agreed to return to what had been the beginning of the close-time for 400 years previously to the passing of the Act of 1828, viz., the 27th August; and the beneficial effects of this change were soon apparent, as, in 1861, the rental had risen to £14,009, 15s. 7d. By the Act of 1862, the close-time was fixed from 21st August to 4th February, and it was afterwards changed by Order under the Secretary for Scotland's hand from 27th August to 10th February. The rental reached its highest point in 1886, when it was £22,542, 2s. 8d. Since then it has fallen off. But not more than might naturally occur, owing to the fluctuations of the seasons and other disturbing causes.

Loch Tay

In Loch Tay 81 salmon, weighing 1470 lbs., were captured in 1891 between the 15th January and the commencement of the netting season on the 11th February; and between the 11th February and the close of the fishing season of 1891 244 were caught, weighing 4381 lbs., or a grand total of 325 salmon, weighing 5851 lbs., or an average of 18 lbs.

*Table showing the Number and Weight of Trout killed in Loch Leven in each Month during the past Six Years.*

| | 1891. | | | 1890. | | | 1889. | | | 1888. | | | 1887. | | | 1886. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Month. | Number. | Weight. | Average of Each. | Number. | Weight. | Average of Each. | Number. | Weight. | Average of Each. | Number. | Weight. | Average of Each. | Number. | Weight. | Average of Each. | Number. | Weight. | Average of Each. |
| | | lbs. | lbs. | | lbs. | lbs. | | lbs. | lbs. | | lbs. | lbs. | | lbs. | lbs. | | lbs. | lbs. |
| April.......... | 556 | 418 | ·775 | 1174 | 1071 | ·912 | 494 | 386¼ | ·774 | 1025 | 997½ | ·972 | 1559 | 1434½ | ·919 | 706 | 570½ | ·807 |
| May........... | 4762 | 3686½ | ·763 | 4649 | 3593¾ | ·772 | 2413 | 1928 | ·799 | 4456 | 2992¼ | ·671 | 3175 | 3581 | 1·127 | 2465 | 2071¾ | ·840 |
| June.......... | 5196 | 3985½ | ·767 | 2630 | 2064½ | ·784 | 2449 | 1977½ | ·807 | 7811 | 6669 | ·853 | 3285 | 3071¾ | ·934 | 3282 | 2907½ | ·885 |
| July .......... | 724 | 707½ | ·977 | 993 | 1043 | 1·050 | 1382 | 1266½ | ·916 | 3992 | 3889¾ | ·974 | 2960 | 2986¼ | 1·008 | 1943 | 1991¾ | 1·025 |
| August ....... | 3898 | 3354 | ·860 | 1319 | 1299¼ | ·984 | 6306 | 5184 | ·822 | 4833 | 5046¼ | 1·044 | 6688 | 6171 | ·922 | 3422 | 3660½ | 1·060 |
| September.. | 925 | 728¼ | ·787 | 172 | 130¾ | ·755 | 2501 | 2145 | ·857 | 1399 | 1479 | 1·057 | 235 | 219 | ·931 | 120 | 128 | 1·06 |
| Total......... | 16,058 | 12,830 | ·798 | 10,937 | 9202¼ | ·841 | 15,485 | 12,837 | ·828 | 23,516 | 21,073¾ | ·896 | 17,902 | 17,464 | ·975 | 11,938 | 11,299¾ | ·946 |
| Netted .... | 268 | 343 | 1·279 | 313 | 347 | 1·108 | 298 | 387 | 1·298 | 90 | 114 | 1·266 | 178 | 256 | 1·438 | 219 | 325 | 1·484 |
| Total....... | 16,326 | 13,173 | ·806 | 11,250 | 9549¼ | ·848 | 15,783 | 13,224 | ·837 | 23,606 | 21,187¾ | ·897 | 18,080 | 17,720 | ·980 | 12,157 | 11,624¾ | ·956 |

*Statistics of Fish taken from Musselburgh Esk from* 1886 *to* 1891, *both years inclusive.*

| Month. | 1886. | | 1887. | | 1888. | | 1889. | | 1890. | | 1891. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Fish. | Weight. | Fish. | Weight. | Fish. | Weight. | Fish. | Weight. | Fish. | Weight. | Fish. | Weight. |
| February (from 11th, Opening Date), | 39 | 28½ | 240 | 151¾ | 80 | 46 | 183 | 112 | 273 | 158 | 143 | 86 |
| March, | 34 | 26 | 153 | 85½ | 79 | 51¼ | 207 | 118½ | 249 | 162¾ | 43 | 27¼ |
| April, | 137 | 117 | 80 | 35¼ | 350 | 238½ | 159 | 83 | 36 | 19¼ | 101 | 57¼ |
| May, | 37 | 31 | 70 | 29½ | 33 | 18¼ | 56 | 25 | 3 | 1¼ | 9 | 4¼ |
| June, | 9 | 5¾ | 85 | 32 | 15 | 9¼ | 15 | 7¾ | 39 | 11¼ | 2 | ¾ |
| July, | 1 | ½ | 56 | 23 | 555 | 207 | 29 | 13 | 479 | 182 | 6 | 2¾ |
| August, | 63 | 36¾ | 143 | 59 | 814 | 303 | 606 | 337¾ | 836 | 444½ | 488 | 269 |
| September, | 184 | 103¼ | 568 | 375 | 224 | 86¼ | 175 | 97 | 123 | 62 | 359 | 195 |
| October, | 158 | 116¼ | 217 | 125 | 112 | 51½ | 404 | 232½ | 175 | 102 | 168 | 103 |
| Approximate Totals, | 662 | 465 lbs. | 1612 | 916 lbs. | 2262 | 1011 lbs. | 1834 | 1026½ lbs. | 2213 | 1143 lbs. | 1319 | 745¼ lbs. |
| Average Weight, | ... | 11¼ oz. | ... | 9 oz. | ... | 7⅓ oz. | ... | 9 oz. | ... | 8¼ oz. | ... | 9¼ oz. |

Loch Leven.

The Annual Report of the 'Loch Leven Angling Association' shows that 5076 more trout were killed in 1891 than in 1890.

The Loch was, with the permission of Sir G. Graham Montgomery, Bart., kept open to anglers till the 5th of September, being five days beyond the usual period of closing. The exceptionally cold weather in April and May, and the unusually dry, clear weather of the greater part of the remainder of the season, were most adverse to successful angling; but, notwithstanding these unfavourable circumstances, the season as a whole has been a fair average one, and a great improvement on the previous year.

The following Table shows the number and weight of trout killed in each month during the past six years (see page viii).

During the past year 606 pike have been killed, weighing 2081 lbs.

The usual hatching operations were continued with success, and nearly 300,000 healthy fry were deposited in spring in the feeders of the Loch.

Esk Angling Improvement Association.

The following is an extract from the Annual Report of the Esk Angling Improvement Association, who have now for six years leased the lower part of the Musselburgh Esk, and have been stocking it artificially, and carefully protecting it.

*Statistics of Fish Taken.*—The following Table of fish captured during the past angling season has been compiled from the water-bailiff's reports. It is proper to state that the figures given in the Table are *under the mark,* the water-bailiff not having been able always to obtain the particulars of every basket (see page ix).

The average weight of each fish for 1891 is 9¼ oz. There have been more fish taken during the past season, running from 1 lb. to 1½ lbs., than during almost any previous season. The largest fish taken during the year was a sea-trout of 1½ lbs. There were no specially large fish taken during the year, but, both in the early part of the season, and in the back end, a considerable number of sea-trout were taken about 1½ lbs. The largest yellow trout weighed 1¼ lbs., and several were captured approaching that weight. More yellow trout have been taken than in previous years.

Inspections during 1891.

During 1891 Mr Young, the Inspector of Salmon Fisheries, inspected the Ericht, Shee, and Ardle, the Lunan, Lochs Venachar, Achray, and Katrine, and connecting and tributary streams; the salmon-ladders on the River Ballisodare; the salmon-ladder on the Moriston at Invermoriston; Loch Torridon, the Balgay River and Loch Damph; the Nith and Annan Districts on the Solway; and the River Truim, a tributary of the Spey.

The Ericht, Shee, and Ardle.

The Ericht below Blairgowrie, where the Salmon Fisheries used formerly to be of great value, is now utterly salmonless, owing to obstructions, pollutions, and the almost total abstraction of the water in the river, when it is low, by the enormous lades which supply the manufactories at Blairgowrie. The Tay District Board, some years ago, placed Macdonald Fishways on two impassable dams on the Ericht; but, unfortunately, it turned out that these Fishways which have proved so successful in the United States of America are not suited to our rapid Scotch highland streams, which, when in flood, bring down great quantities of gravel and other débris, which choke up the tubes upon which the successful action

of the Macdonald Fishway depends, and so render it useless. The beautiful highland streams, the Shee and the Ardle, which unite to form the Ericht about 6 miles above Blairgowrie, and each of which has a course of about 15 miles, are at present salmonless, because no fish can possibly surmount the obstructions at Blairgowrie.

The Lunan

The Lunan is a small river with a course of about 14 miles which falls into the Isla 3 miles above the junction of that river with the Tay. There are 5 considerable lochs belonging to the basin of the Isla which at present contain only pike, perch, and trout, but to which salmon might easily be enabled to have access by opening up an impassable dam about 2 miles above the junction of the Lunan with the Isla. The way in which this might be done is pointed out in Mr Young's Tenth Report to the Board which immediately follows this.

---

Loch Venachar, Loch Achray, and Loch Katrine.

Loch Venachar and Loch Achray and their connecting streams, contain salmon and trout; Loch Katrine has no salmon; but, unfortunately, all these lochs also contain a great number of pike, and the innkeepers in the neighbourhood, to whose hotels anglers resort in considerable numbers during the summer and autumn months, are very anxious to discover some effectual means of extirpating or thinning out the pike with the view of improving the salmon and trout fishing. This, however, is no easy matter in lochs of such depth and extent, though a good deal may be done in the spawning season when the pike resort to narrow ditches and water-runs, also by the use of hang-nets, and by what are called liggers or trimmers.

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The Salmon-ladders on the Ballisodare River.

The Ballisodare River falls into a southerly branch of Sligo Bay on the West Coast of Ireland. Thirty years ago it did not contain a single salmon. It now yields from 8000 to 10,000 salmon annually. It is formed by the junction of two streams, the Owell and the Arrow, the latter of which flows through and out of Loch Arrow, a fine lake 5 miles long and nearly a mile wide. The drainage area of the Ballisodare River is about 300 square miles. Previously to the erection of the ladders, this river was entirely unproductive, and might have remained so to this day but for the intelligence and enterprise of a single individual—Mr Edward Cooper—who opened up the obstructions and enabled the fish to have free and uninterrupted access to the fine spawning grounds above, with the gratifying and remarkable results that, 11 years after the completion of the ladders, 10,000 salmon were caught in a river which had never produced one before. What was done on the Ballisodare might as easily be done in Scotland, on the Tummel, the Spean, the Conon, and on several other rivers,† but for the unsatisfactory state of the law with regard to the claims of the Crown to newly created Salmon Fisheries, and the claims of certain proprietors under old charters to follow salmon, in the event of a natural obstruction being opened up, even although the river and the lands on both sides of it above the obstruction do not belong to them.

* A full account of the causes of the failure of these Fishways will be found in Mr Young's Eighth Report, pages 5–8, and Note 8 to that Report.

† For a full account of all the natural obstructions on the salmon rivers of Scotland, see Mr Young's Sixth Report to the Board, pages 30–58.

There are three obstructions on the Ballisodare River, the first consisting of a perpendicular rock, 22 feet in height, stretching right across the mouth of the river just where it falls into the sea; the second, a little way further up, 12 feet high; and the third, at Collooney, about a mile and a half above the river's mouth, 22 feet 6 inches high. The ladders are all on the same principle of construction, being on the pool and jump-system, with an easy gradient and spacious pools. They are all in two parts which form an angle with each other. The Collooney ladder, at the angle formed by the junction of its two branches, has a spacious resting pool about 15 feet square. At the top of each of the ladders there are sluices regulating the flow of water.

Salmon-ladder at Invermoriston.

The River Moriston flows through Glen Moriston into Loch Ness after a course of 20 miles from Loch Clunie a loch 5 miles long and about half a mile wide. It is a perfect model of a small salmon river, with beautiful streams and pools, and fine spawning ground. But nearly half a mile above its junction with Loch Ness, a rock, 28 feet high, intercepts its course over which the whole body of the river rushes in a picturesque but utterly impassable waterfall. Mr Grant of Glenmoriston, however, has placed a ladder upon this Fall, which, although not as yet as successful as the ladders on the Ballisodare, has enabled a good many salmon to reach the upper waters, as salmon have been caught 16 miles above the Falls, and a number of parr have been seen, showing that the fish have bred in the river.

The Balgay River and Loch Damph.

The fishings in the Balgay River, the Inspector states, are very remote and inaccessible, being at least 15 miles from the nearest Inn. Before fixed nets were erected at the narrows in Loch Torridon, into which the Balgay falls, the river fishings in the Balgay and Torridon, which flow into the head of the Loch, were of great value; so much so, that they have been repeatedly conveyed by name since 1624; the half of the fishings of the Balgay even being thought worthy of being split into two equal portions in 1624, between the representatives of the two heirs portioners of Donald of the Isles; and, to come to more modern times, the case of 'Stuart *v.* M'Barnet,' 30th March 1867, was carried through all the Courts to the House of Lords for their exclusive possession. At present, however, the Balgay does not produce thirty salmon in the year. Yet, in the case of Stuart *v.* M'Barnet, many of the witnesses spoke as to the immense numbers of fish in former times. Thus George Mackenzie, elder, 83 years old, said, 'He would get eight 'or nine salmon a night poaching in the old time. Remembers a 'new net broken by the weight of fish in the mouth of the Balgay; 'fifty salmon were caught on that occasion.' Alexander Chisholm, Keeper to Sir John Stuart, stated in the same case 'that he fished 'the mouth of the Balgay from 1861 to 1863 with net and coble, 'and caught as many as 400 to 600 salmon, including grilse, in a 'season.'

The Balgay River issues from Loch Damph, and, after a course of about a mile, falls into Loch Torridon. Loch Damph, which is situated in Applecross Parish in west Ross-shire, is a wild but picturesque sheet of water, 3½ miles in length by half a mile in

width, surrounded by the mountains of Earl Lovelace's Deer Forest. A considerable stream falls into the head of it, on which are two smaller lochs on the property of Mr Murray of Loch Carron.

There is a considerable Fall on the Balgay between Loch Damph and Loch Torridon, which, though not an entirely impassable obstruction, forms a very serious impediment to the ascent of salmon. But this Fall might be made easily accessible at no great expense, either on the right or on the left bank. On the right bank, the best plan would be to divert the water temporarily to the left bank, and blast out the top of the Fall on the right bank, make a resting pool between the top of the Fall and the pool at the bottom, and widen the opening from the pool on the right bank to the pool on the left bank. It would, however, be as effectual, and certainly cheaper, to attack the Fall on the left bank where there is a sort of natural salmon-ladder which goes quite round the Fall and which does not require much alteration to make it into an excellent and efficient fish-way. All that would require to be done would be to remove some boulders, and to deepen and widen the passage in one or two places; also a little blasting might have to be done at the top of the Fall.

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Annan and Nith Districts.

In the districts of the Annan and the Nith, the Inspector found the paidle-nets, which have been so often declared by Government Commissions and by Courts of Law to be engines set up and used for the taking of salmon, still fishing under the name of white-fish nets. The whammel or hang-nets, too, which rake the low-water channel of the Firth, are still as active and deadly as ever, and will remain so until the Act 7 & 8 Vict. cap. 95, and its amendment by the 25th section of 'The Salmon Fisheries (Scotland) Act, 1868,' are made to apply to the Solway Firth. There is a very objectionable lade in the Annan District, at Newbie Mill, long, wide, and deep, and without any hecks or gratings either at the intake or the tail-lade, which has been again and again complained of, but which the Annan Board have as yet taken no steps to guard in conformity with the terms of the Bye-law. At present it is a perfect salmon-trap.

Pollution of the Nith.

The pollution of the Nith below Dumfries Cauld, owing to the sewage of Dumfries and the poisonous chemicals poured into it from tweed mills and dye-works, has very much increased of late years. The Fisheries below the Cauld have, in consequence, greatly fallen off in value; and, in some places, what were once good netting pools are now filled up and rendered useless by fetid mud. It is understood that the Nith District Board intend to take steps against the polluters. But clause 13 of the Salmon Fisheries Act of 1860, as amended, or rather emasculated, by clause 16 of the Act of 1868, are so worded as to make it very difficult indeed to get a conviction for pollution. And, until a provision is introduced in some future Act giving to each District Board, within its own district, the same powers of prosecution for the prevention or abatement of pollutions in rivers and waters, as are at present competent to riparian owners in such district, it will be found very difficult to deal effectually with polluters.

Legislation for the prevention and cure of pollution and poisoning in all running waters is most important and urgent. The evil is yearly increasing, and it is time that a remedy was applied. And that such a remedy might be found without injury to manufacturers there seems to be but little doubt; as, more than 15 years ago, the River Pollution Commissioners wrote as follows in their 5th and last Report:—'We have thus already submitted to your 'Majesty a description of the evils arising from the discharge into 'river channels of town sewage, and of the various filthy drainage 'waters from cotton, woollen, silk, flax, and jute works, from print 'and dye-works, from tanneries, paper mills, and bleach works, from 'alkali, chemical, and soap works, from distilleries, starch and sugar 'works, and from parrafin oil works. The remedies for the nuis-'ances which these refuse liquids create have been carefully 'examined, and, after prolonged inquiry and research, we have been 'able to report that in every case efficient remedies exist and are 'available; so that the present use of rivers and running waters 'for the purpose of carrying off the sewage of towns and populous 'places, and the refuse arising from industrial processes and 'manufactures, can be prevented without risk to the public health 'or serious injury to such processes or manufactures.'

It seems, therefore, quite evident that the secondary uses of water which the manufacturers enjoy have been too long allowed to usurp the place of the primary uses to which the public are entitled, and that it is high time that stringent measures were taken to check the progress of pollution, which has already converted so many of our streams, once pure and pellucid, into mere fetid sewers. In one way, at least, the public health and the preservation of salmon are immediately connected. The water which will destroy or repel salmon is unfit for human use; and the water fit for human use is attractive and wholesome for salmon. The state of the matter was admirably stated by the late Mr Russel of the *Scotsman* in the chapter on 'Future Salmon Legislation,' in his well known work entitled *The Salmon*. 'Some people,' he remarks, 'venture to say 'that the infliction of sterility on the waters by artificial means 'is natural, because river courses are the natural drains of the 'country, and because thus it is natural that all dirt should descend 'through these drains. But there is neither proof nor probability as 'to this being a correct interpretation of the designs of nature in 'the making of rivers; and, though it were otherwise, the fact would 'not be much to the purpose. Nature, we beg to suggest, intended 'river courses for rivers, and rivers are naturally composed of water 'that rises from the ground, and water that falls from the clouds, 'there is no written proof nor visible probability that nature 'designed river courses as conduits or open sewers for the running 'off of lime, soda, and vitriol. On the contrary, there is good 'evidence that nature intended rivers, among other good purposes, 'to furnish a supply of drink to man, beast, and bird, to say nothing 'of fish; and it is a fair inference that whatever renders rivers unfit 'for so obvious and great a purpose is a violation of the designs of 'nature. Indeed, it would be quite enough to say that nature, 'beyond all doubt, designed rivers to be the habitation of fish; and 'that if lime, vitriol, soda, and filth are incompatible with fish, it 'is not the fish but the filth that is out of place.'

**Salmon-ladder on dam in the Milk Water.**

When the Inspector was in the Annan district a very efficient salmon-ladder was being placed on what used formerly to be an impassable dam on the Water of Milk, a tributary of the Annan, above which there are several miles of fine spawning ground. It is stated that a number of salmon have since passed through it to the upper waters.

**The Truim.**

The last river visited by the Inspector was the Truim, a valuable spawning tributary of the Spey, into which it falls at Invernahaven, 6 miles south-west of Kingussie. The Spey District Board complained that the proprietor of Glentruim had placed an illegal artificial obstruction across the bed of the Truim, which not only formed a fine lie for salmon but also materially interfered with the free passage of fish to the upper waters. There seems to be no doubt that the complaint of the Spey District Board is well-founded, and that the obstruction is illegal and might be got rid of, at the instance of the Spey District Board, by an action of Declarator and Removal or other legal process.

**Fishery Board and the Salmon Fisheries of Scotland.**

It seems to be desirable, now that the Fishery Board have been nearly 10 years in existence, to glance briefly at the work which it has done in connection with the Salmon Fisheries. We venture to think that a reference to the Reports of the Board and of the Inspector of Salmon Fisheries will shew not only that all the Salmon Fisheries in Scotland, including those in the Inner and Outer Hebrides, and in the Orkney Islands, have been carefully inspected, but also that the best means of improving the river and sea-fisheries have been laid before Parliament in the Annual Reports. That many of these improvements have not been carried out, owing to various opposing causes, the Board regret. But the record remains of what might be done and how to do it, and the suggestions made may yet possibly be carried into effect.

It ought also to be kept in view, with reference to the Board's procedure with regard to the Salmon Fisheries, that their powers under the Act which creates them and defines their authority are of a very limited and indefinite nature. It is true that by the 'Fishery Board (Scotland) Act, 1882,' it is provided by section 5, sub-section 2, that 'The Fishery Board shall have the general superintendence of the Salmon Fisheries of Scotland, and shall have the powers and duties of Commissioners under the Salmon Fishery Acts, but without prejudice to or interference with the powers of District Boards.' It is somewhat difficult to define—and it is nowhere defined or determined—what powers are conferred on the Fishery Board by the words 'general superintendence.' Then as to 'the powers and duties of Commissioners under the Salmon Fishery Acts,' it is well-known that the Scotch Salmon Fishery Commissioners, whose office came to an end in 1882, had very limited powers. They could not constitute a district, fix an estuary, inspect a river, or report on a complaint from a District Board, without first applying to the Secretary of State for permission to do so. In fact, they had nothing like the power of any English Board of Conservators under the 39th section of the English Salmon Fisheries Act of 1873. Under these circumstances, it would certainly seem desirable that the powers and duties of the Fishery Board with regard to the Salmon Fisheries, and especially with regard to those

numerous Fishery Districts in Scotland which have no District Board, should be defined with more clearness and precision.

In spite, however, of the limited and indefinite powers possessed by the Fishery Board, something has been done to improve the Salmon Fisheries since their institution. The Shetland Islands, with their valuable and varied sea-trout and yellow trout fishings, have been brought under the operation of the Scotch Salmon Fishery Acts; natural obstructions in the case of several rivers have been opened up, and Salmon permitted to reach spawning grounds to which they never previously had access; several dams over which Salmon had formerly to be lifted by the river watchers have been altered so as to afford an easy passage to ascending fish; the close-time applicable to many rivers has been changed so as to be more in conformity with the physical characteristics of each river; and, in one or two instances, attempts have been made to abate pollutions by the establishment of sewage-farms or the use of catch-pits. Little, however, comparatively, has been done of what the Board strongly recommended to be done.

Improvements in a future Salmon Fisheries Act which would be generally acceptable.

Before closing our Report, it seems desirable to state briefly certain improvements which might be made in the existing Salmon Fishery Acts, all of which have been recommended in the various Reports of the Board since its constitution in 1882, and most, if not all of which, would, we believe, be agreed to by both upper and lower proprietors, if embodied in a new Salmon Fisheries Bill. We purposely avoid all contentious matter.

Prohibition of the sale of fish caught during the extension of time for rod-fishing

1. The sale of Salmon caught during the extension of time for rod-fishing should be prohibited. It is very properly prohibited both by the Tweed and by the English Salmon Fishery Acts; for, as long as the market is open, nets will be used for its supply as well as rods, and great facilities and encouragement will be given to illegal fishing. The following letter from Mr Eden, one of the original Commissioners of Scotch Salmon Fisheries, to Mr Young, clearly shows that it was the intention of the Commissioners to prohibit such sale:—'My Dear Sir,—I hear from Mr Leslie that 'you desire to know what was the opinion of Mr Leslie's colleagues 'in the original Salmon Fisheries Commission respecting the per- 'mission to sell Salmon caught by rod after the net season is closed. 'Mr Ffennell's opinion was at one with mine in this, as in most 'other points respecting the Salmon Fisheries; and the whole 'Commission, while desiring to permit the rods to fish longer than 'the nets, were most anxious to prohibit fish so taken by the rod 'from being sold or offered for sale. I think this most desirable, 'for as long as the market is open it will be supplied, and for its 'supply nets will be used as well as rods.'

District Boards to remain in office until their successors are appointed.

2. At present, if a District Board neglects to observe the statutory triennial election, the Board lapses, and there is no means of reconstituting it under the existing Salmon Fishery Acts. It would be desirable to insert a provision, in any future Act, that District Boards shall remain in office until their successors are appointed, and giving power to the sheriff of a county, on the petition of any two proprietors of Salmon Fishings in a district in that county, to reconstitute a District Board, which has been allowed to lapse owing to a neglect to observe the statutory

triennial election provided for by section 24 of the Salmon Fisheries Act of 1862.

3. Every District Board, within its own district, should have the same powers for the prevention of pollutions in rivers and waters as are at present competent to riparian owners in such district. At present District Boards have no such power, and they can only prosecute under the 13th section of the Salmon Fisheries Act of 1862, and its so-called Amendment, by the 16th section of the Act of 1868, which have proved utterly inadequate to prevent or abate pollutions.

Power to District Boards to prevent pollutions.

4. It was recently decided in the case of Captain Dunbar Brander of Pitgaveny, who is proprietor of Salmon Fishings in the sea in the district of the River Lossie, and lessee of all the rod-fishings in that river, that he was not entitled to prosecute the manufacturers on the Lossie for having no hecks on the lades and no fish-passes on the dams connected with their manufactories, because there is no District Board for the Lossie, and the 29th section of the Salmon Fisheries Act of 1862 provides that, 'In the event of 'any person refusing or neglecting to obey any Bye-law made by 'the Commissioners, the Clerk may apply to the Sheriff by 'summary petition in ordinary form, praying to have such person 'ordained to obey the same, and the Sheriff shall take such pro-'ceedings and make such orders thereupon as he shall think fit.' It has been held that, under this section, no one but the Clerk to a District Board can prosecute for the contravention of a Bye-law; and the effect of this decision is simply to make the Salmon Fishery Acts and relative Bye-laws inapplicable and useless in the numerous fishery districts where there are no District Boards; for the Bye-laws regulate districts, estuaries, close-time, meshes of nets, dams, lades and water-wheels, cruives, and fixed engines; and, if no one but the Clerk to a District Board can bring an action for a breach of any of these Bye-laws, it is clear that, wherever there is no District Board, the Bye-laws may be violated with impunity.* The remedy is either to insert after the word 'Clerk,' in the above quoted section, the words 'or any pro-'prietor of salmon fisheries in the district,' or to make an addition to the 37th section of the Salmon Fisheries Act of 1868, which will then read as follows—the additional words being printed in italics:—'Any proprietor of a fishery shall be held to have a good 'title and interest at law to sue by action any other proprietor or 'occupier of a fishery within the district, or any other person who 'shall use any illegal engine or illegal mode of fishing for catch-'ing salmon within the district, *or who shall contravene or fail to* '*observe any Bye-law*.'

Proprietors of Salmon Fisheries to be entitled to prosecute for contravention of Bye-laws where there is no District Board.

5. In addition to hecks upon lades, there should be a provision for smolt-proof gratings above mill-wheels, and especially above turbine-wheels, at the time when the smolts are descending to the sea. Diagrams illustrating the construction and use of such smolt-guards will be found in Appendix No. 10 to the Report of the Select Committee appointed to inquire into the present state of the laws affecting the Salmon Fisheries of England and Wales, printed in 1870. The 30th clause of 'The Salmon Fisheries

Smolt proof-guards to be placed above mill-wheels.

* See also the case of 'Blair *v.* Sandeman & Lumsden, 20th July, 1869.'

'(Ireland) Act, 1863,' provides that 'Where a turbine or similar 'hydraulic machine which may be injurious to salmon, or the young 'of salmon, in their descent to the sea, is supplied from rivers 'frequented by salmon, the person owning or using such a machine 'shall, during the time in which such descent to the sea takes 'place, provide gratings or other efficient means to prevent such 'salmon or young of salmon from passing into such machine.'

*Prohibition of fishing in lades.*

6. It might be advisable to insert in any future Act a prohibition against fishing in any lade belonging to any mill or manufactory by any net, engine, or device, under a penalty of £5 for each offence, and forfeiture of the net, engine, or device used in such fishing. It is well-known that a great deal of poaching takes place in such lades. This prohibition should not apply, however, to the proprietor of the Salmon Fishings in that part of the river from which the lade is supplied, or to any one who has permission from him.

*Definition of what constitutes a fixed engine.*

7. There is no definition, either in the Act of 1862 or in that of 1868, of what constitutes a fixed engine. The following definition would, it is thought, be unobjectionable, and it would have the effect of effectually preventing the use of the deadly and destructive hang-net in rivers and estuaries:—'From and after the 'passing of this Act, the terms "fixed net" and "fixed engine" 'shall respectively mean and include any net or engine used, or 'which may be used, for the capture of salmon, saving and excepting fishing by net and coble, as lawfully used and practised at the 'time of the passing of this Act.'

*Prohibition of the gaff or cleek until the 1st May.*

8. There appears to be a pretty general feeling in favour of prohibiting the use of the gaff or cleek for landing salmon until the 1st May. At present it may be used in all the rivers of Scotland, except the Tweed, during the whole year. Yet it seems somewhat inconsistent and absurd to legislate for the preservation of kelts, and at the same time to allow them to be lacerated by the cleek in landing them. If it is intended to preserve kelts, the landing-net or the hand only should be used until they have left the river. The netting season on the Tweed closes on the 15th September; and 'The Tweed Fisheries Amendment Act, 1859,' provides by its 16th section that 'every person who shall, between 'the 15th day of September in any year and the 1st of May in the 'year following, in fishing with a rod and line, use any cleek or 'instrument for landing fish other than a landing-net, shall be 'liable to a penalty not exceeding £5.' In England, Boards of Conservators have power to make a Bye-law prohibiting the use of the gaff during certain times of the year.*

*Power to river-watchers to take diseased fish out of rivers.*

9. In practice, District Boards instruct the river-watchers to take diseased fish out of rivers and to bury them above the highest flood-mark in cases where the salmon disease has shown itself. But there is no specific power in the Acts entitling the District Board to give such instructions, as there certainly ought to be. In connection with this subject, it should be mentioned that some

* Some steps should also be taken to prevent the practice of "sniggling," or, as it is called in England, "strokehalling," which is prohibited under a penalty by the English Salmon Fisheries Act of 1873. (See my first Report to the Board, page 177.)

gentlemen of distinguished scientific attainments are of opinion that the burying of diseased fish, except at a great distance from the river, is of very doubtful utility, because rain filtering through the soil might carry the germs of infection back into the water. If this view be correct, cremation would be the only remedy.

10. By the 33d section of the Salmon Fisheries Act of 1868, the penalty for an offence under that Act or the Act of 1862 is to be not less than half the greatest penalty that may be imposed on a conviction for a second offence, and the full penalty for a third or any subsequent offence. But, in practice, it not unfrequently happens that a mere illusory penalty, such as 2s. 6d. or 5s., is imposed for a first offence. We venture to think that there should be a *minimum*, as well as a *maximum*, penalty, and that the former should be one-fourth of the latter (see section VI., sub-section *a.*, of Summary Procedure Act, 1881). Minimum Penalties.

11. There are about 500 miles of rivers and 40,000 acres of lochs in Scotland barred against salmon by obstructions in the shape of impassable water-falls. In some of these cases, the cost of enabling salmon to surmount the obstruction would probably not be repaid by the increased value of the waters opened up. But, in the great majority of cases, the cost of opening up the barrier would be amply repaid. As the law at present stands, however, it is only by agreement with the proprietor of the obstruction that District Boards can get permission to make it passable. If the proprietors refuse, neither the District Board nor the Fishery Board for Scotland, nor the Secretary for Scotland, can do anything. They are utterly helpless. In a Salmon Fishery Bill brought in, in 1861, by Lord Advocate Moncreiff and the late Sir George Lewis, the following clause provided compulsory powers for making natural obstructions passable for salmon:—'If any natural 'obstruction shall exist in any river which prevents the free 'passage of salmon, salmon-ladders shall be constructed so as to 'permit and allow such passage at all times over, across, or through 'the same, and if the owner of the soil, land, or fishery, in or upon 'which such obstruction exists, shall refuse or neglect to allow such 'salmon-ladder to be constructed within fourteen days of being 'thereunto required in writing by the Central Board or their 'Secretary, or by the District Board or their Clerk, or by any 'surveyor or inspector, it shall be lawful for the Central Board or 'for the Sheriff within whose jurisdiction the obstruction or cause 'of interruption is wholly or partially situated, upon the applica-'tion or information of the Clerk of the District Board respectively, 'to order and direct that such salmon-ladders shall be constructed 'by, or under the inspection or direction of, a proper person to be 'appointed by the Central Board or District Board or such Sheriff, 'and at the expense of the District Board, in such manner as may 'sufficiently effect the object intended with the least possible 'injury to the property of such owner.' Compulsory power to District Boards to make natural obstructions passable for salmon.

12. Under the 39th section of the English Salmon Fisheries Act of 1873, Boards of Conservators have received pretty extensive powers to make Bye-laws for the better protection, preservation, and improvement of the Salmon Fisheries within their respective districts; and of this power Mr Willis Bund remarks in his 'Law Power to District Boards to make Bye-laws.

'of Salmon Fisheries in England and Wales':—'Perhaps the most 'important part of the Salmon Fishery Act, 1873, is the power 'given to Boards of Conservators to make Bye-laws for the better 'execution of the Salmon Fishery Acts, 1861 to 1873, within their 'district. Before 1861 various local Acts regulated the fisheries in 'different rivers, but the Salmon Fishery Act, 1861, repealed all 'these, so far as they related to salmon, and laid down the principle 'of one fixed law for every river in England and Wales. Although 'the principle was sound in theory, yet in practice it has been 'found absolutely necessary that it should be relaxed in some 'degree. Each river has its own peculiarities of detail, and these 'can never be dealt with by general legislation; what is most vital 'for one river may prove ruinous for another; and hence for a long 'time past Boards of Conservators have been asking for power to 'adapt the law to the circumstances of their district. This power 'has at last been granted, and each Board can now, within the 'limits prescribed by the Act, modify the general law so as to suit 'the peculiarities of its district.' It might possibly be worth considering, with reference to any future Act, whether a similar power might not be advantageously conferred on District Boards in Scotland, under certain limitations and restrictions.*

Illicit traffic in salmon.

13. In our Seventh, Eighth, and Ninth Reports we had the honour of bringing under your notice the extensive illicit traffic in salmon from various parts of Scotland to English and foreign markets; and in our last Report we write, as follows, with regard to the best means of checking it:—'The Board regret 'to state that the illicit traffic in salmon from Newburgh and 'elsewhere on the Tay, and from other localities in Scotland, to 'English and foreign markets, still continues, no legislation having 'yet taken place to carry out the steps which we had the 'honour to recommend in our Seventh Report as necessary to 'prevent it. As the matter is one of much importance, and as it 'is understood to be occupying the attention of the Fisheries 'Department of the Board of Trade and of the Fishmongers 'Company of London, we beg to recapitulate what was there re'commended:—"What is chiefly required in Scotland are powers '"of search and seizure, conferred on officers of District Boards, '"river-watchers, police officers, &c., such as are given with regard '"to game by the 2nd section of the Poaching Prevention Act '"of 1862; the prohibition of the sale, offering for sale, or having '"in possession for the purpose of sale, of salmon caught during '"the extension of time for rod-fishing; and the throwing on '"persons in whose possession salmon are found, in a district '"where the annual close-time has commenced, the *onus* of prov'"ing that they got them in a district where it was still legal to '"take them. All these advantages have been possessed for some '"years past in England, and why they should be withheld from '"Scotland where the salmon fishings are far more valuable, and '"the facilities for poaching so much greater, it is difficult to com'"prehend. Generally speaking, it may be said that the English

* Such Bye-laws, of course, should not be at variance with the provisions of the Salmon Fishery Acts, and should require the sanction of the Secretary for Scotland before coming into operation.

'"Acts throw the burden of proof to a great extent on the '"persons in whose possession unseasonable salmon are found, '"whereas the Scotch Acts, as interpreted by the Courts, throw it '"on the prosecutor. It may also be stated that the Tweed '"Fisheries Act of 1859, section 10, throws the burden of proof '"on persons selling, or offering for sale, salmon caught during the '"annual close-time, that such fish were not taken contrary to '"the provisions of the Act; and, in the 19th section of the '"English Salmon Fisheries Act of 1873, the burden of proof is '"also thrown upon the person having unseasonable salmon in his '"possession."'

14. As regards the Scottish side of the Solway Firth, where the salmon fisheries suffer so much from the ravages of the whammel or hang-nets, the great thing wanted is to make the Act 7 & 8 Vict. cap. 95, and its Amendment by the 25th section of the Salmon Fisheries Act of 1868, to apply to the Solway Firth. That Act and its Amendment have proved most efficacious in preventing and suppressing salmon poaching in other parts of Scotland. It is owing to a mere legal technicality that they cannot be enforced on the Scottish shore of the Solway, and there can be no doubt whatever that they ought to be made to apply to it. This matter will be found fully discussed in the Tenth Report of the Inspector of Salmon Fisheries, who visited the Nith and Annan Districts on the Solway in the course of last summer, and whose Report immediately follows that which we have now the honour to submit.

The Solway Firth.

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In the course of last autumn, while on a visit to America, Sheriff Guthrie-Smith, the Vice-Chairman of the Board, was much impressed by the remarkable facilities afforded by a recently invented fish-way for enabling the migratory salmonidæ to surmount dams and other obstructions in salmon rivers. The inventor is Mr Robert Hockin, one of the Inspectors of Fisheries in Nova Scotia. His fish-way has been patented both in Canada and in the United States of America, and has received the approbation of such competent judges as Mr Wilmot, Superintendent of Fish Culture in Canada, and Colonel Marshall Macdonald, the Head of the Fishery Commission of the United States at Washington. The Vice-Chairman has received plans of this fish-way, which are hereafter reproduced in our Report, and which will clearly show its characteristics.

The Hockin Fish-way.

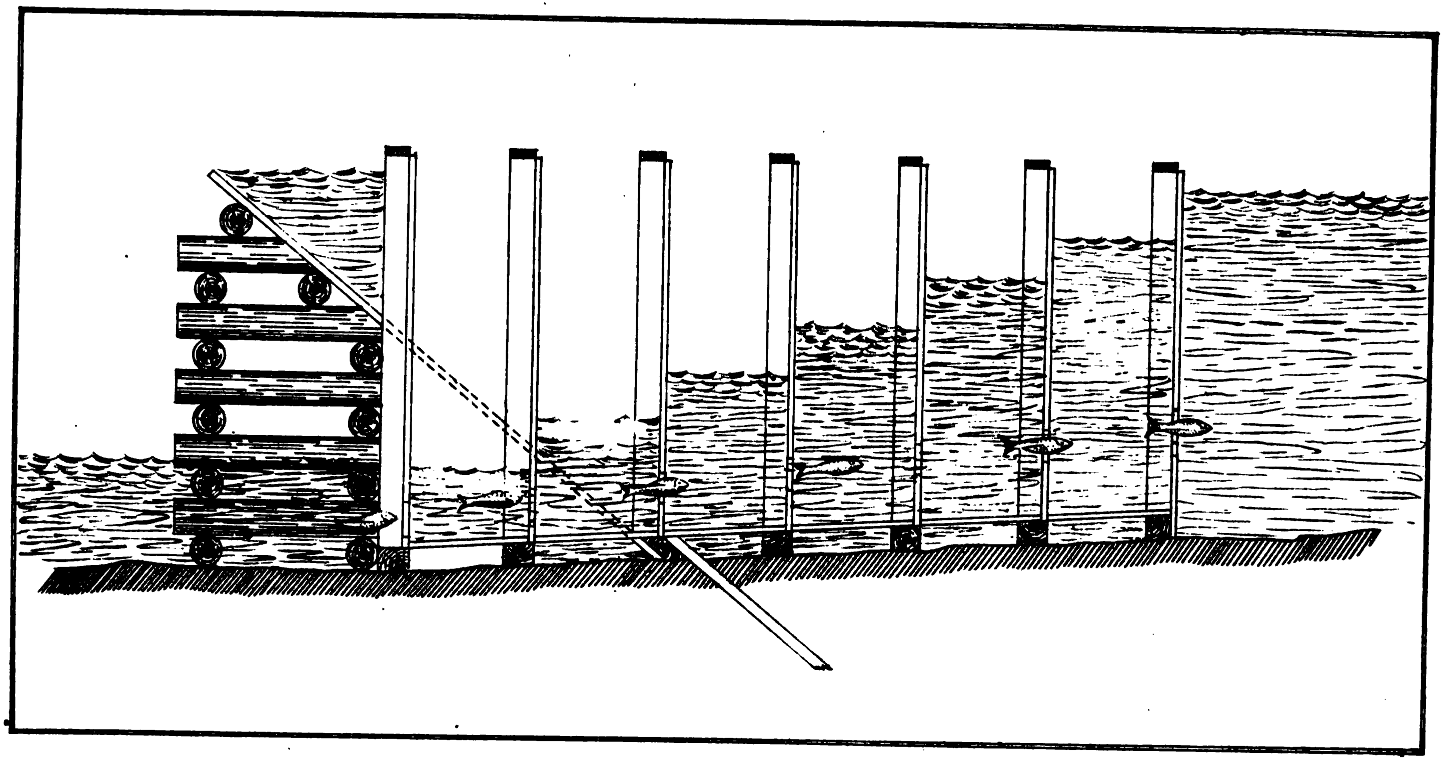
The chief object of a fish-way is to enable migratory fish to pass easily over the obstruction on which it is placed, whenever the river is in such a state as to induce them to run. No fish-way that does not fulfil this condition can be called a successful one. A fish-way should be easy of access, and should be placed in such a position as to attract the fish. It should also not be too expensive and should not require frequent repairs. Yet, how few of our fish-ways in Scotland fulfil these conditions. Either the gradient is too steep, so that the rush of water prevents the ascent of running-fish; or the fish-way is made in the wrong place; or the supply of water to it is liable to be obstructed; or the fish-way itself is apt to be choked up by gravel and débris; or it is liable to be injured by freshets and ice so as to need constant repairs. It is thought that

the Hockin fish-way is, in a great degree, exempt from these objections.

Many forms of fish-way have been devised to facilitate the ascent of running-fish, such as Mr Cail's lock swimming pass in England, Colonel Macdonald and Mr Brackett's fish-ways in the United States of America, and the fish-way of Mr Rogers in Canada; all of which are clever and ingenious, and have been successfully applied in various parts of Europe and America. But, on the whole, the recent invention of Mr Hockin seems, in some respects, superior to any of them. One special advantage of it is, the position of the orifice through which it is supplied with water. The supply can never fail so long as there is water in the dam—and this is a great point—as the orifice is far below the level of the water in the dam. Whether the orifice will not be liable to be choked up with the gravel, which is brought down in floods, by some of our rapid Highland rivers, is a point more difficult to determine. Most of the fish-ways in Scotland are supplied with water through a cut made in the crest of the dam; so that, whenever the water falls below the crest, the supply ceases, and the pass is useless.

The following description by its inventor, and the drawings which illustrate and succeed it, will give a good idea of the peculiarities and advantages of the Hockin fish-way:—'Deciding that the 'great defect of fish-ways in use was from the fact of their being 'fed from the surface, and that it would be of great value if one 'could be obtained that was fed from beneath, I instituted a series 'of experiments last winter with this object in view, and succeeded 'in inventing a pass which is a simple solution of the difficulty. 'It may shortly be described as a hole in the bottom of the dam, 'with the velocity of the discharge so reduced that a fish may con-'tend against the current, and swim into the pond above. It con-'sists of a series of compartments, having approximately a level 'floor, with side walls, ends, and transverse partitions (every 4 feet of 'its length) from the bottom of the dam to above the water line; 'these compartments connected with one another, and with the pond 'above and the river below the dam, by submerged apertures 'approximately on the level and preferably in alignment for the 'passage of fish. The water in the several compartments will be 'lower, step by step, from inflow to outlet, and will flow out of the 'last aperture under a head of about 2 feet (it can be made less), 'and, therefore, with so little velocity that fish can swim into the 'first compartment and into the pond above. Here, then, is a fish-'way which is not of very great length, 28 or 32 feet, sufficient 'for any average dam. It is built from the bottom of the pond 'up, so that ice cannot form under it nor raise it; and from its 'structure, with partitions every 4 feet, it is necessarily strong and 'compact. Freshets can make no torrent through these passes 'and tear them out. The apertures being submerged cannot be 'choked with débris, and they can be so far removed from the 'bottom as to obviate any danger from that source. What is per-'haps most important is, that it adapts itself to the height of water 'in the dam; for, so long as there is water in the dam, the fish-way 'will be supplied. The importance of this will be recognised when 'it is remembered that a fish-way has no friend in the mill-owner,

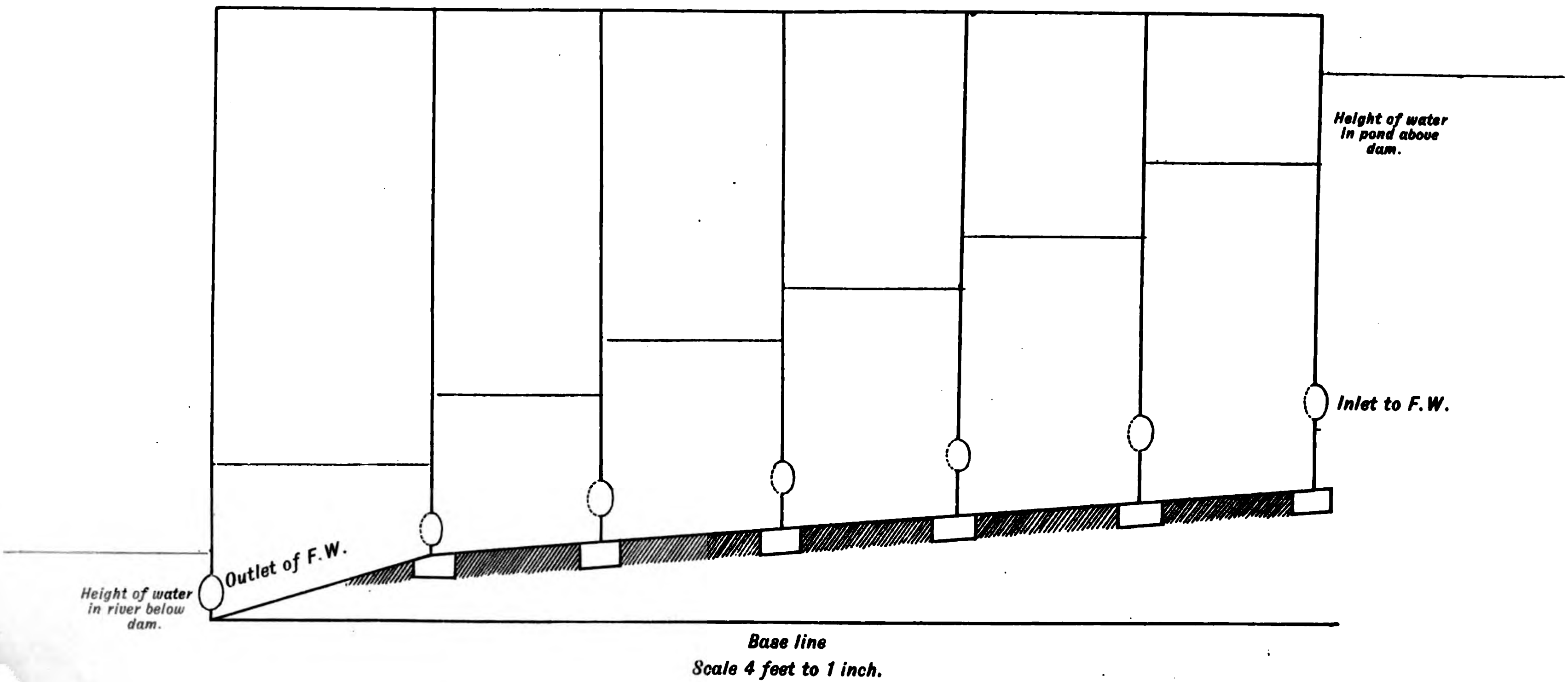
# PLATE I.



SCALE ONE-SIXTH INCH = 1 FOOT.

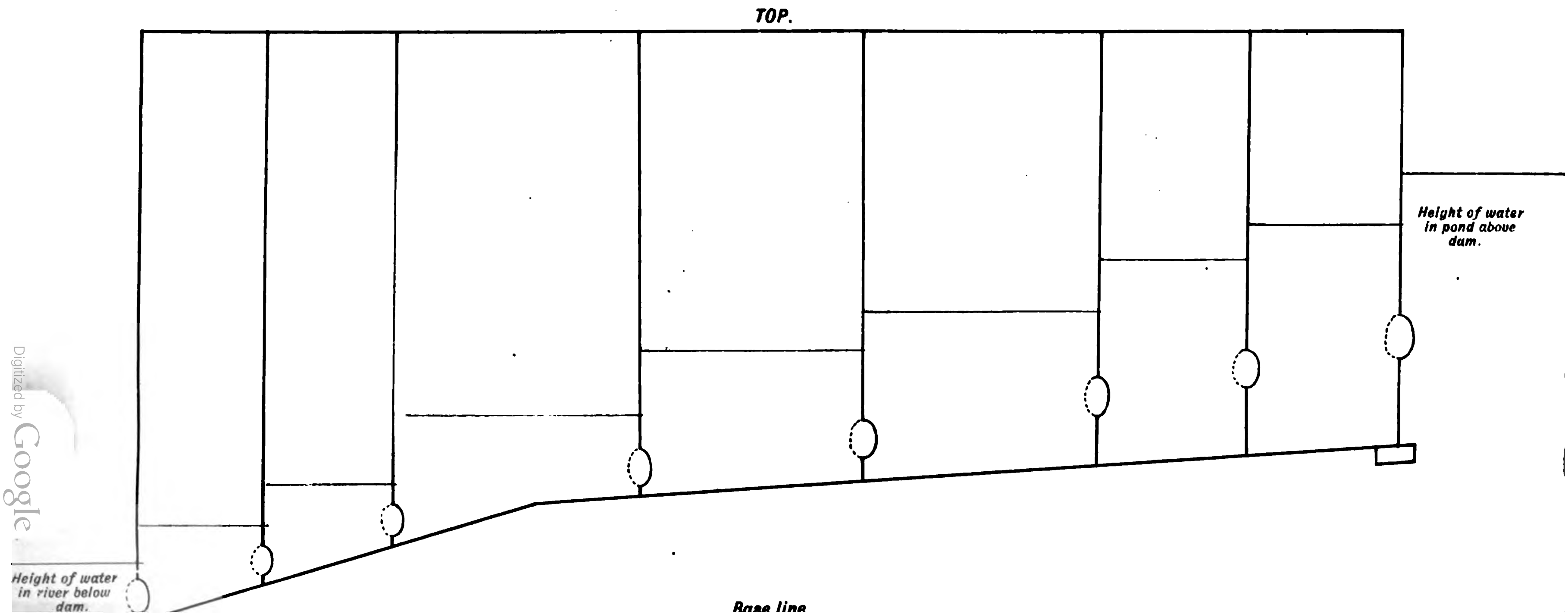
# PLATE II.

Side Section of Hockin Fishway as constructed in Cummingers Dam, Guysboro Co., N.S. Lines in red showing actual height attained by water in the several compartments.



# PLATE III.

Side Section of Hockin Fishway constructed at Doyles Dam, Tidnish, County of Cumberland, Nova Scotia, built at the same time and made part of a Road-Bridge; compartments adapted to the upright supports of the bridge. Lines in red showing height attained by the water in the several compartments, also showing incline given to fishway to adapt it to the grade.



'and that the maintenance of the rights of free access to spawning 'grounds depends upon the vigilance of Fishery Officers. The 'velocity of discharge being so reduced, the loss of water does not 'materially affect the mill-owner.'*

Plate I. gives a side view of the fish-way as constructed with aperture of discharge under the water in the river below the dam. Here, under the darkened shadows of the dam, the light shining through the aperture is quite noticeable.

Plate II. shows the heights of the water attained in the several compartments in the fish-way on Cumminger Dam where a Hockin fish-way has been placed, and Plate III. in the fishway on Doyle's Dam. In the latter fishway the aperture was oval-shaped, 11 inches high and 9 inches wide. In the Cumminger Dam it was 9 inches high, 7 inches wide, and of the same shape. There is ample evidence to show that fish have gone through them with a full head of water.

We have the honour to be,

My Lord,

Your Lordship's most obedient Servants,

THOMAS J. BOYD, *Chairman.*
JOHN GUTHRIE SMITH, *Deputy-Chairman.*
GEORGE H. M. THOMS.
D. M'KECHNIE.
J. R. G. MAITLAND.
J. COSSAR EWART.
JAMES JOHNSTON.
WILLIAM BOYD.
W. ANDERSON SMITH.

* A working model of the Hockin Fishway has been sent from Canada, and may be seen at the Office of the Fishery Board, 101 George Street, Edinburgh.

# APPENDIX.

## TENTH ANNUAL REPORT TO THE FISHERY BOARD FOR SCOTLAND

ON THE

## SCOTTISH SALMON FISHERIES IN 1891

BY

ARCHIBALD YOUNG, ADVOCATE,
INSPECTOR OF SALMON FISHERIES FOR SCOTLAND.

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## NOTES TO REPORT.

# REPORT.

I HAVE the honour to report that on the 4th and 5th of June last, in company with the Vice-Chairman of the Fishery Board, Mr White, Solicitor, Forfar, and Mr Malloch, of Perth, the inventor and patentee of Malloch's Automatic Fish-pass, I carefully inspected the obstructions on the River Ericht between Blairgowrie Bridge and Westfield dam which prevent salmon from having access to what was, early in the present century, one of the best salmon-fishings in Scotland, and also to the rivers Ardle and Shee, which unite to form the Ericht a few miles above Blairgowrie.

Obstructions in the River Ericht between Blairgowrie Bridge and Westfield dam, and in the lower portions of the Ardle and Shee.

That the salmon-fishings in the Ericht, for 2 miles downwards from the rapid and fall termed the Keith, were at one time excellent—though that fine stretch of water is at present salmonless—there can be no doubt whatever.

In Sir John Sinclair's *Statistical Account of Scotland*, published between 1790 and 1800, the following occurs in the description of the parish of Blairgowrie:—'The Keith, a natural cascade, considerably improved by 'art. It is so constructed that the salmon, which repair in great numbers 'to it, cannot get over it unless when the river is very much swelled. '. . . Many gentlemen from all quarters repair to this river for amuse-'ment. From the Keith, for about 2 miles down the river, there is the 'best rod-fishing to be found in Scotland, especially for salmon.'

In the account of the parish of Rattray it is stated that 'sportsmen 'look upon the Water of Ericht as one of the finest rivers for rod-fishing, 'both for trout and salmon.' It is also stated that 'sometimes salmon 'are caught in the Ardle, and it abounds in trouts.'

So recently as 1835, as can be shown from the Valuation Roll of the county of Perth, these fishings were worth £164, 16s. annually. At present no one would give £1 a year for them, so utterly are they ruined by obstructions and pollutions, and the abstraction of almost all the water when the river is low by the enormous lades which supply the mills and manufactories at Blairgowrie.

In his well-known work, *The Angler's Companion to the Rivers and Lochs of Scotland*, published in 1845, Mr Stoddart writes as follows:—'The Ericht is formed by the junction of the Shee or Blackwater with 'the Ardle, and is received into the Isla about 2 miles below Blairgowrie. 'Neither the Ericht or Isla are much esteemed as trouting streams, *and 'in regard to Salmon, with which at one time they abounded*, these are 'now, comparatively speaking, scarce, at least during the open season. 'The whole rental of the Ericht, from Keith to Blairgowrie, amounts 'only to £21, 12s.; whereas, in 1804, no fewer than 336 salmon and 'grilse were taken at one haul close to the above-mentioned village.'

In 1870, Mr Stoddart wrote me as follows about the Ericht:—'Your

'inquiries about the Ericht lead to the recollection that I stayed a week 'at Blairgowrie in August 1861, and my impression at that time was, 'that, as a tributary of the Isla, and one of the feeders of the Tay qualified 'in an eminent degree for the reception of breeding salmon, it was 'receiving cruel treatment at all hands. The fish were purposely, I 'understood, kept down by one of the influential proprietors near the 'mouth, and rarely found opportunity to gain the fine stretch of spawning-'ground extending towards the Bridge of Callie, and beyond it into the 'Shee and Ardle. The Act of 1862, I thought, had put to rights the 'then existing abuses, but it appears it has not done so.'

It is quite apparent from the above authorities that the salmon-fishings in the Ericht, within living memory, were of considerable value. It is equally apparent that they have now almost ceased to exist.

On Thursday afternoon I carefully inspected the obstructions at Blairgowrie, beginning with Westfield dam, which is highest up the river. At the time the Ericht was very low, owing to the long continuance of dry weather, and scarcely any water was coming over the dams, while long stretches of the river's bed were nearly quite dry, owing to the almost total absorption of the water by the lades. Not a drop of water was coming over Westfield dam, and the Macdonald fishway, on the left bank of the river, had the appearance of having been dry for weeks, and was very much choked up with gravel.

The state of the Ericht in dry weather shows that the recommendation made twenty years ago by Mr Buckland and myself, in our Report of 1871, that some control should be exercised by legislative enactment over the quantity of water taken from salmon rivers by millers and manufacturers was not uncalled for.

The dam at Ashbank and its Macdonald fishway were in the same position as those at Westfield.

When I visited the Keith, which is a long, narrow, foaming rapid, headed by a fall of considerable height and volume, I was told by the gardener at Keith House that he had sometimes seen salmon in the deep pool at the foot of the Keith, but he did not think that they ever succeeded in getting up. I adhere to the opinion which I expressed many years ago, when I first inspected the Keith, that the only way to enable salmon to ascend is to cut a pass through the conglomerate rock on the right bank, beginning a good way up, pretty close to the right bank, and to carry this cutting down to nearly the foot of the rapid, not far from which there is a sort of natural salmon-ladder in the rocks.

The fishway on the low dam immediately above Blairgowrie Bridge is in the wrong place, and is too smooth. But when the river is in such a state as to induce salmon to run—that is to say, clearing and subsiding after a flood—I think that they will be able to ascend over the rough stones that form the face of the dam.

Between this dam and the Keith there is a second and considerably higher dam, with a fishway on it formed of smooth wooden planks—about the worst material of which a fishway can be constructed. This should be roughened by having planks nailed on at intervals. I was glad to see, however, that a suggestion I made some years ago has been given effect to, and that a cut has been made through the crest of the dam down to the head of the fishway.

On Friday, the 5th June, I inspected the Ericht above Westfield dam, and the lower portions of the Ardle and Shee. There are some fine rocky pools and streams on the Craighall Water, on the Ericht. There are about 6 miles of the Ericht between Westfield and the junction of the Shee and Ardle near Bridge of Cally. The Ardle has a course of

13, and the Shee of 15 miles. The former, for several miles above the junction, abounds in fine gravelly spawning-ground, and has several good pools suitable for salmon, if they could only be enabled to reach them. The Shee is a much more rapid stream than the Ardle, and its bed is more rocky. It falls nearly 700 feet in 15 miles. It abounds, however, in splendid pools and streams. But at Netherton Bridge there is a dam connected with a wool mill, which forms a most serious obstruction, 9 feet perpendicular, which no salmon could surmount. There is no fish-pass.

Junction of Tay and Isla.

It is stated by several persons well qualified to judge that, owing to a change in the stream of the Tay close to its junction with the Isla, caused by the erection of a croy on the right bank of the Tay, where there is at present a ferry, salmon do not take the Isla so freely and readily as they used to do. At the junction the Isla is dead water, almost without a current, whereas there is a strong current in the Tay, which proves more attractive to the fish than the dead water in the Isla. If this be the case, unless a change can be effected by removing the croy, the proposed restoration of the salmon-fishings in the Ericht below the Keith, and the bringing salmon up into the Shee and Ardle, will be greatly increased in difficulty, as the Ericht is a tributary of the Isla, and all salmon reaching it must of course first pass through the Isla.

Obstructions on the Lunan.

A few miles from Blairgowrie there is a very objectionable artificial obstruction on the small river Lunan, which I saw and examined in the course of my inspection, and which was complained of by various persons in the neighbourhood as entirely preventing the ascent of salmon to several lochs belonging to the basin of the Lunan.

The Lunan has a course of 15 miles, and flows into the Isla about 3 miles above the junction of that river with the Tay. The dam in question is situated only 2 miles above the point where the Lunan joins the Isla. It is of considerable height, with a long face or apron, and has no fish-pass. At present it is an absolute obstruction. Above it there is a long series of lochs, containing only pike, perch, and trout; but if this dam were made passable, salmon would have access to the whole of them, which would immensely increase the value of the fishings. These lochs together cover an area of at least 500 acres. Their names are as follows:—Loch Drummellie, Loch of Cluny, Loch of Butterstone, Loch of the Lows, and Loch Craignish. It would not be very difficult or expensive to make this dam passable by building a subsidiary dam across the narrow channel of the stream a little way below the main dam, and placing a diagonal plank or board along the apron of the main dam. But I was informed by Mr Anderson of Blairgowrie that the Lunan above the dam does not bring down gravel when in flood. And if this be the case, it occurred to me that the utterly inefficient Macdonald fishway at Westfield, which is choked up with gravel and so rendered useless whenever the Ericht is in flood, might be removed and applied to the dam on the Lunan, of course with the permission and consent of the Tay District Board.

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Inspection of Loch Venachar, Loch Achray, and Loch Katrine.

On the 11th of June last I commenced my inspection of Loch Venachar, Loch Achray, and Loch Katrine, and their connecting and tributary streams.

Before the erection of the Glasgow Water Works Embankment and Sluices at the outlet of the Teith from Loch Venachar, salmon had free access into the loch, and the Coilantogle Ford, immortalised by Sir Walter Scott, was immediately below the efflux of the river from the lake.

The Forth District Board and the Commissioners of Scotch Salmon Fisheries, after much trouble and many meetings, at last succeeded in making an arrangement by which salmon were enabled to ascend to Loch Venachar by the old river channel, and so avoid the totally impracticable barrier presented by the embankments and sluices at the head of the new cut.

I have several times visited the Embankment and Sluices at the outlet of Loch Venachar, the first time in 1870, along with the late Frank Buckland. At that date scarcely any salmon could get up, and in their answers to the printed queries issued in 1870 the Forth District Board write as follows :—'The works at the outlet of Loch Venachar totally prevent the 'passage of fish to a large area of first-rate breeding water. They were 'erected only a few years ago, but the effect of them has been to render 'unavailable about 2 miles of spawning ground. On an examination 'and report made for the Forth District Board, it was stated that only 'two fish had been seen in the river above the loch during the whole of 'the spawning season of 1868.'

Since the above was written, however, matters have much improved, and a good many salmon now yearly find their way into Loch Venachar and the spawning grounds above, as many as twenty-nine fish having been captured in a year in the loch above the embankment. But none of these salmon get up by the new cut and the water works' sluices and ladders. They all ascend by the old river channel. At the waste-weir leading into it on the left bank beyond the sluices, there is an efficient fish-pass, with a gradient of 1 in 20, that of the apron of the weir being 1 in 6. Below this there are two other weirs, each having a fish-pass with an easy gradient in order to facilitate the passage of salmon. If, when the river is in flood and the compensation water is given through the sluices, the remainder was regularly sent over the waste-weir into the old river channel, fish would not have much difficulty in ascending. But there should be some one, in the interests of the Forth District Board, to see that this was regularly done. Loch Venachar is a beautiful sheet of water, nearly 4 miles in length, and upwards of half a mile in maximum width. Besides salmon, it contains very fine trout, perch, and large pike. It is connected with Loch Achray by a stream upwards of a mile long called the Dubh Abhain. Loch Achray is much smaller than Loch Venachar, being only a mile and a quarter in length and from 2 to 3 furlongs wide. The Achray water flows into it from Loch Katrine. It contains trout, sea-trout, pike, and perch. There is no reason why there should not be salmon also, as there is no obstruction on the stream between Loch Achray and Loch Venachar. But they are rarely caught. The landlord of the Trossachs Hotel, however, told me that two were caught in 1890 and two in 1891. I walked up the beautiful wooded valley through which the Achray water flows from Loch Katrine into Loch Achray. This stream is a mile and three-quarters in length, and when in flood is amply sufficient in volume to allow salmon to ascend into Loch Katrine. But there is an obstruction near the efflux of the river from the loch, in the shape of the sluices belonging to the Glasgow Water Works, which effectually prevents their upward passage. Between the end of the sluices and the farther or left bank of the outflow from Loch Katrine, there is a low dam of massive stones, and below that a rocky and broken stretch of stony ground. I think that the best way to enable salmon to get up without interfering with the sluices would be to make a cut in this dam close to the sluices, and to carry it down into the Achray water, opening out into the stream below the totally inefficient salmon ladders connected with the sluices. If this were done—and it would not be a costly operation—when the

river was in flood and fish running up they would first meet the stream from this new cut and ascend by it into the loch, instead of vainly attempting the present impassable salmon ladders.

Loch Katrine is a grand and beautiful loch with magnificent surroundings of rock, mountain, and woodland. It is 364 feet above the sea, and measures 8 miles in length by nearly a mile in extreme width off Letter Farm. It has a maximum depth of 78 fathoms. The Glengyle water, in which there is good spawning ground, flows into its head, and no fewer than forty-eight streams and rivulets leap down the hill-sides to join its waters. It contains char, abundance of fine trout, and pike running up to 20 lbs. weight. But during the twenty years I have been connected with the fisheries, I have never heard of any salmon being captured in it. As already mentioned, there is fine spawning ground in Glengyle water, and so there is also in the Stob-a-Chair water, which runs into Loch Katrine opposite the Black Island. If the alteration I have suggested near the sluices on the Achray water should ever be carried out, it might be worth while putting salmon fry into these two streams. The trout fishing in Loch Katrine has greatly improved since the level of the loch was raised several feet for the supply of Glasgow with water. Stronachlachar Hotel is the best station for the angler, and about the finest fishing in the loch is between that hotel and Glengyle.

Difficulty of keeping down the Pike in these Lochs.

The chain of lakes which I have described, beginning with Loch Venacher and ending with Loch Katrine, are all much infested with pike, to the great detriment of the salmon and trout fishing; and the innkeepers at the Trosachs Hotel, and at Stronachlachar and Callander, are greatly exercised in their minds how to thin out or exterminate the pike. My old friend and colleague, Frank Buckland, used to recommend trying to destroy them in spring in their spawning season, when they ascend ditches and shallow runs of water, for the purpose of propagating their species. Hang-nets have also been recommended. But in large and deep lochs such as those in question it is almost impossible to get rid of pike. Sixty years ago there were no pike in Loch Tulla, from which the River Orchy, the chief feeder of Loch Awe, issues. The trout fishing in Loch Tulla, both for quality, number, and weight, was then unsurpassed in Scotland. But, unfortunately, pike were put in, and in a short time they not only nearly ruined the fishing in Loch Tulla, but also found their way through the Orchy into Loch Awe; so that the chief expense of the Loch Awe Fisheries Improvement Association is now incurred by their efforts to thin out the pike; and the Marquis of Breadalbane is compelled to have recourse to netting and other means to keep down the pike in Loch Tulla, and in its tributary streams, especially the Luine-nan-Beathach.

That pike have long been a scourge to salmon fry and trout in the lochs of the Trossachs district is shown by the following extract from the account of the parish of Callander, taken from Sir John Sinclair's *Statistical Account of Scotland* published about a hundred years ago. 'Salmon,' says the writer, 'are found in the Teith and in the northern branch thereof, all the way to 'Balquhidder. They are much more rare in the southern branch, owing, 'probably, to the large pikes in Loch Venachar and Loch Achray, which 'are enemies to other fish. Trouts abound in all the lakes and streams of 'this parish; and parrs in every stream. Whitings, which some fisher-'men say are young salmon, which others reckon a distinct species of 'trout, are common in the Teith in July and August. Pikes and jacks 'are very numerous in Loch Venachar and Loch Achray, in the south 'branch of the Teith, and in some stagnant pools near Callander. They 'grow to a large size, and are frequently caught from 11 to 20 lbs. each. 'They may be taken at all times with bait, for which parr are esteemed best; but they are most esteemed in June, July, and August.'

If it is desired to take pike out of a loch, it is most difficult to do so by means of an ordinary drag-net. They will avoid it in the cleverest manner possible. The best plan is to set a trammel-net along the edge of the weeds, and then beat the latter and drive the fish out, when they will mesh themselves in the net. Evening is the best time to kill the larger pike, who, during the day, remain in the deep water, but come in at nightfall to the shore to the mouths of the burns that run into the loch, where they find small trout and other food brought down by the streams.

Liggers or Trimmers for killing Pike.

A deadly mode of killing pike is by liggers or trimmers. The ligger or trimmer is a long cylindrical float made of wood, or cork, or rushes tied together at each end; to the middle of this float a string is fixed from 8 to 15 feet long; this string is wound round the float except 2 or 3 feet when the trimmer is to be put into the water, and slightly fixed by a notch in the wood or cork, or by putting it between the ends of the rushes. The bait is fixed on the hook, and the hook fastened to the end of the pendent string, and the whole is then dropped into the water. By this arrangement the bait floats at any required depth, which should have some reference to the temperature of the season—pike swimming near the surface in fine warm weather, and deeper when it is colder, but generally keeping near their peculiar haunts. When the bait is seized by a pike, the jerk loosens the fastening, and the whole string unwinds—the wood, cork, or rushes floating at the top indicating what has happened. Floats of wood or cork are generally painted, to render them more distinctly visible on the water to the fishers who pursue their amusement and the liggers in boats. Floats of rushes are preferred to the others, as least calculated to excite suspicion in the fish.

Some writers of high authority on all matters relating to sport have expressed a strong opinion that pike should not be extirpated or thinned out in large and deep lochs like Loch Venachar and Loch Katrine. Mr St John, for example, writes as follows on the subject in his charming volume *Sport in Morayshire*:—'It is a fallacy to suppose that pike 'are detrimental to the sport of the fly-fisher—that is, in the Highland 'lakes, where there is depth and space enough for both kinds of fish to 'live and flourish; of course pike kill thousands and tens of thousands 'of small trout, but the fault of most Highland lakes is that there are too 'many trout in them, and the fly-fisher works for a month without killing 'a trout above a pound weight; pike keep down the overstock; there are 'still plenty and more than plenty of trout remaining in the water, and of 'a better size and quality than where they are not thinned. I have invari-'ably found this the case, and that I could catch a greater weight of 'trout in a loch where there are pike than where the trout had no enemies 'to keep down their daily increasing numbers, besides which, though the 'pike is piscivorous, he is also most decidedly as omnivorous as a pig or 'an alderman; a great part of the food of the pike consists of frogs, 'leeches, weeds, &c.; young wild ducks, water-hens, and even water-rats, 'do not come amiss to him. Like a shark, the pike when hungry 'swallows anything and everything that has the misfortune to come within 'reach of his murderous jaws. If the fact could be ascertained, I would 'back a *salmo ferox* of 10 lbs. weight to kill more trout in a week than a 'pike of the same weight would in a month. I never killed a large trout 'without finding the remains of other trout within him, sometimes, too, 'of a size that must have given him some trouble to swallow. In fine, 'I am strongly of opinion that pike should be encouraged in all large 'Highland lakes where the trout are numerous and small. There is no 'doubt, too, that the large trout, with a due respect to the *lex talionis*, 'feed on the infant pike as freely as the pike feed on the young trout.'

There is a beautiful stream running for 7 miles through Glen Finglas, an ancient deer forest of the Scottish kings, which joins the Dubh Abhain at Bridge of Turk, a quarter of a mile below the foot of Loch Achray. In its upper part it is a steep and rapid torrent, but in the middle portions there is a considerable extent of beautiful gravelly spawning ground. But, unfortunately, below this the stream plunges into a deep, rocky, picturesque gorge where there are several rapids and waterfalls which at present forbid the ascent of salmon. The attention of Mr Buckland and myself was directed to these many years ago, and our opinion then was that it was better to leave matters alone, as it would cost too much to open up the spawning ground; and a careful examination, in the course of last summer, convinces me that our opinion was correct. There are several falls in the lower course of the stream. One of these is about a mile above the Bridge of Turk, and is not less than 9 feet in height; but on the right bank there is a sort of natural salmon ladder, with a resting pool in the centre, which without much expense might be widened, deepened, and made more easy in gradient, so as to allow salmon to ascend. Above this is another fall, almost, if not quite, insurmountable, as on the very crest of the fall there is a projecting rocky ledge, against which fish attempting to ascend would be certain to knock their heads and fall back into the pool below. This ledge would require to be blasted away, in the event of any attempt ever being made to enable fish to ascend to the spawning grounds above. Besides these, there are several smaller falls in the gorge. But they would scarcely stop salmon. Below all these falls there are beautiful, deep, rocky pools, forming fine lies for fish.

Falls in Glen Finglas.

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There can be no doubt that the number of salmon, grilse, and sea-trout annually brought to the market would be immensely increased if the principal natural obstructions, in the shape of waterfalls, which at present prevent the ascent of salmon to hundreds of miles of rivers and thousands of acres of lochs, were made passable; and upon this subject the Fishery Board, in their ninth and last Report on the Scotch Salmon Fisheries, have expressed a very decided opinion, after having uniformly and consistently advocated such a change in the existing laws as would enable natural obstructions to be made passable, even in the case where the proprietors of the obstruction refused their consent—due compensation, of course, being made to such proprietors for any injury to fishing or amenity which they might sustain.

Salmon Ladders on the Ballisodare River, County Sligo, Ireland.

In their ninth Report they write as follows, on page 10:—'There are 'three chief causes that have operated to prevent the opening up of the 'obstructions which at present bar about 500 miles of rivers and lochs 'against the ascent of salmon. These are (1) the natural unwillingness 'of the proprietors of such falls to allow them to be interfered with, 'sometimes because there is a productive pool immediately below the 'falls, which they fear might be spoiled; sometimes from consideration of 'amenity—such proprietors possessing at present an absolute veto, there 'being no means provided by which arrangements can be made for 'opening up the falls, and compensating the proprietors in the case of 'their refusing their consent; (2) the claim of the Crown to all the new 'Salmon Fisheries that may be created by the opening up of natural 'obstructions by the riparian owners; and (3) the claim put forward in 'certain cases by a proprietor below a fall—founding upon a charter 'granting him the Salmon Fishings throughout a whole district of 'country—to the Salmon Fishings above the fall in the event of its

'being opened up, though neither the fall nor the river above it are his 'property. But for the operation of these three causes, we believe that 'many of the natural obstructions in our Scotch salmon rivers would by 'this time have been made passable.'

The second and third of the causes above enumerated do not operate in Ireland; and in that country we accordingly find that the most successful and remunerative attempts have been made to open up natural obstructions by means of salmon ladders.

The most remarkable of these attempts was made about thirty years ago on the Ballisodare River, which falls into a southerly branch of Sligo Bay, on the west coast of Ireland. The Ballisodare has a drainage area of nearly 300 square miles. It is formed by the junction of two streams—the Arrow and the Owell—the former of which flows through Loch Arrow, a fine lake 5 miles long and nearly a mile wide.

The obstructions on the river are three in number, and are of the most formidable character—the least of them being more difficult to overcome than the Falls of Tummel. Previously to the erection of the ladders, the Ballisodare River never contained a single salmon; since the erection of the ladders, it has produced from 8,000 to 10,000 salmon annually. In the latter part of June last, I carefully inspected these ladders by the direction of the Fishery Board.

The obstructions consist of a perpendicular rock 22 feet in height, stretching across the whole breadth of the mouth of the river, just where it falls into the sea. When the river is in flood it dashes over the rock in a splendid cascade, which tourists come from a great distance to see. The ladder is on the right bank of the river. Its mouth enters the chief pool below the falls, where the principal lie of the fish is. It is on the pool-and-jump system; the stops, formed of stone, each crossing the whole breadth of the ladder, with the exception of about a foot, where there is a free opening down to the floor of the ladder. The gradient is so easy—about 1 in 10 or 11—that the salmon never jump from pool to pool, but swim up through the openings left at the end of the stops. As many as sixty-seven salmon have been counted going up this ladder in the course of an hour. The ladder is in two parts, which form an angle with each other. The pools in the lower part are very spacious—about 9 feet square.

A short distance above the first fall is the second, a perpendicular rock 12 feet high, termed the 'Pothole.' Here there is a second ladder, on the same principle of construction as the first, with this exception, that for a short distance above where it enters the pool below the fall it passes through a tunnel cut in the rock.

The third and last obstruction occurs at Collooney, about a mile above the 'Pothole.' Here there is a perpendicular rock, 22 feet 6 inches in height, and a ladder of the same description as those on the two lower falls, with this addition, that at the junction of the two branches of the ladder there is a spacious resting-pool about 15 feet square. At the top of each of the ladders above described there are sluices regulating the flow of water.

I was informed that the cost of the ladders above described was £7000; and I was at the same time told that the clear profit of the Fishery opened up by them, after paying all expenses, including the expense of a hatchery, averages about £1500 a year—certainly a handsome return for the outlay.

There is a good deal of rocky ground in the bed of the Ballisodare River unsuitable for spawning. But on the main stream and its two chief tributaries there are at least 7 miles of fine gravelly spawning

ground. There are about 30 miles of river and several lochs above the junction of the Arrow and the Owell.

The hatchery near the mouth of the Ballisodare River is not of the most modern and approved construction, and the river water which they use is by no means perfectly pure. It is capable of hatching out nearly 100,000 salmon fry annually. I was informed that for some time past they have been getting salmon ova from the Rhine, with the view of increasing the size of the Ballisodare salmon, and that the consequence has been a considerable increase in the average annual weight of the fish captured. I saw a number of salmon in the icehouse. They were very handsome fish, and a good many of them were over 20 lbs.

It is somewhat remarkable that though both the Sligo River and the Ballisodare discharge their waters into Sligo Bay within a few miles of each other, the former is a very early and the latter a decidedly late river. The Sligo, which flows out of Loch Gill, a large and beautiful lake, with richly wooded banks and numerous islands, is one of the earliest salmon rivers in the United Kingdom. It opens for netting on the 1st January; and, from the information I received upon the spot, it appeared that, even at that early date, the salmon are in excellent condition.

In the Ballisodare River, on the other hand, the first clean salmon do not make their appearance until the month of March, and the chief run of fish is in July, at which period the grilse and sea trout ascend.

The Fishery Board have obtained working drawings of the Ballisodare ladders, copies of which will be found at the end of their Report.

The Galway Salmon-ladders.

But the Ballisodare is not the only river in Ireland where a great fishery has been developed by individual energy and enterprise. The late Mr Thomas Ashworth, though he did not create an entirely new fishery like Mr Cooper on the Ballisodare, enormously increased the value of an existing fishery by means of salmon-ladders in connection with the Galway River. That river drains Loch Corrib and Loch Mask, two spacious expanses of water, the former upwards of 20 and the latter 10 miles long. The river has but a short course from Loch Corrib to where it joins the sea below the Town of Galway. But Mr Ashworth, at an expense of £2000, connected Loch Corrib and Loch Mask, by means of salmon-ladders on the Cong river, and thus opened up a vast extent of breeding ground which was carefully protected by a strong force of river-watchers. And, in an account which he published, he shows how the yield of the fishery gradually but steadily increased until, from 1603 salmon and grilse in 1853, it had risen annually to no fewer than 20,512, or more than a tenfold increase in 12 years. The following are the figures for these 12 years:—

| Years. | Number of Salmon caught. | Years. | Number of Salmon caught. |
|---|---|---|---|
| 1853 | 1,663 | 1859 | 9,249 |
| 1854 | 3,158 | 1860 | 3,177 |
| 1855 | 5,540 | 1861 | 11,051 |
| 1856 | 5,371 | 1862 | 15,431 |
| 1857 | 4,857 | 1863 | 17,995 |
| 1858 | 9,639 | 1864 | 20,512 |

Mr Ashworth calculates that the number of salmon that ascend the ladder every year is not less than 40,000. The ladder is 47 feet in length and 9¾ feet in width. The gradient is 1 in 9, and a narrow channel about 2 feet wide and 2 feet deep, cut in the obstruction, supplies the ladder with water. The transverse steps in the ladder are formed of masonry, a

foot thick, and have passages down to the floor of the ladder, at their extremities, about 16 inches wide. There are intervals of 3 feet between the steps. The ladder is very rarely completely dry, and that only when the river is exceptionally low. The least flood gives it a sufficient supply of water for salmon to ascend.

Why do we not follow such good examples? There are far better opportunities in Scotland than in Ireland for creating and developing new salmon fisheries, if we would only take advantage of them.

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River Moriston.

In the beginning of July last, I inspected the river Moriston, which joins Loch Ness at Invermoriston. The Moriston flows for 20 miles through Glen Moriston (the valley of the great cascades), and falls into Loch Ness 7 miles north-north-east of Fort Augustus. It rises in Loch Clunie, a loch about 5 miles long and half a mile in extreme width, into the head of which falls the Clunie, a stream nearly 5 miles long. The Moriston is quite a model of a small salmon river, abounding in fine streams and pools. But half a mile or so above its junction with Loch Ness, the whole body of the river rushes over a rock 28 feet in height into a deep spacious pool below. Such a barrier, of course, is utterly insurmountable by salmon in any state of the river. But this barrier has been, to a certain extent, overcome by a salmon-ladder, which has enabled fish to reach the long stretch of river above, and to take advantage of the fine spawning-grounds. The catchment basin of the Moriston is 158 square miles.*

The possibility of turning the Moriston, like the Ballisodare River in Ireland, from a trout into a salmon river, was first brought under my notice by the late Mr Thomas Stoddart, author of the *Anglers' Companion to the Rivers and Lochs of Scotland*, who wrote me as follows on the 21st March 1870 :—'In any survey you may be called to make of our Northern 'Rivers it strikes me that some attention should be paid to the Moriston 'in its capability of being converted from a mere trouting stream into 'one of the finest salmon rivers in Scotland, and that at a comparatively 'small cost. In the course of an angling tour I took in the autumn of '1866 with the Sheriff of Lanarkshire—Glassford Bell—we had occasion 'to pass down Glen Moriston on our way from Glen Sheil to Inverness, 'and I was greatly struck with the range of splendid breeding-ground 'comprehended in the course of the river on its leaving Loch Clunie, 'which of itself would furnish a fine receptacle for salmon.'

Since the above was written, a salmon-ladder has been constructed on the left bank of the river, by which salmon have been enabled to surmount the falls; but as yet not in sufficient numbers to repay the cost which has been incurred, which, I was informed, amounts to nearly £2000. But efforts are still being made to improve the ladder, which are, I venture to think, likely to be crowned with ultimate success. When I visited the river in July last it was in full flood, and there was a strong current in that part of it between the foot of the falls and Loch Ness, which, when the stream is low, is generally comparatively still and quiescent. From sixty to seventy salmon have been seen to pass the ladder in a year, and they have been caught 16 miles above the falls. No grilse have as yet been got; but a number of parr have been seen, showing that the fish have bred in the river. Possibly the cutting of a passage outside the river round the falls on the right bank, as recommended by Mr

Buckland and myself in 1870, would have been the most effectual way of enabling fish to ascend. But it would have cost considerably more than the present ladder. Salmon do not enter the river earlier than the beginning of March. There has been no netting in the pool below the fall. I was told that there are papers in the hands of Mr Grant of Glen Moriston showing that, so far back as 1830, salmon were taken by net and coble in the pool below the fall, and sent to Inverness and sold. I was also informed that the Crown had made a claim in respect of the new Salmon Fishery to be created in the river above the falls by the erection of the present ladder, and that this claim had been ultimately compromised by the payment of a sum of £100 or £150 for a charter from the Crown. The proprietor already possesses a Barony title fortified by prescription to the Salmon Fishings in the river below the fall. It will be remembered that in their 9th Report the Board advert to this claim of the Crown to all new fishings, created by proprietors on a salmon river opening up impassable obstructions, as one of the chief causes that has prevented the removal of such barriers; and it will also be remembered that the Committee on Crown Rights in Scotch Salmon Fisheries, in their Report of May 1890, write as follows:—'The greater the extent of spawning ground that can be opened up the better for the public interest. 'We therefore recommend that in all cases where such obstructions 'exist, riparian owners be encouraged to undertake their removal by 'receiving a charter of the fishings *ex adverso* their lands on favourable 'terms,' and the 12th recommendation of the Committee is:—'On the 'general question of the removal of natural obstructions, when this will 'open up unchartered waters, we would approve of power being conferred 'upon the Fishery Board to require or undertake their removal, and when 'doing so to prepare a scheme regulating the interests of all concerned.'

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**Upper Loch Torridon and Tributary Streams.**

After leaving Glen Moriston, I proceeded northwards to inspect Upper Loch Torridon and its tributary streams. On my way I drove along the side of Loch Luichart from which the river Conon issues to leap over the impassable Falls of Conon. Above these Falls, there are 30 miles of beautiful water comprising several important lochs, including Loch Luichart (6 miles long) and Loch Roshk (4 miles long), which would all be opened up to salmon by making the falls below Loch Luichart passable and the rapid and fall between Loch Luichart and Loch Cullen. A plan for doing this was furnished by the late Mr William Patterson, C.E., of Inverness, many years ago, and would have been carried out by the upper proprietors if the Crown had not demanded too large a sum for granting them rights to the new fishings, which would have been thereby created.

Loch Torridon is a spacious sea-loch belonging to Applecross parish in Ross-shire. Its upper part is very remote and very picturesque, more than a dozen miles from the nearest inn. From its mouth the loch stretches nearly 8 miles eastward to the entrance of Loch Shieldag, and then 6 miles farther eastward to the foot of Glen Torridon. It measures 4½ miles across the entrance, contracts near Sheildag to less than half a mile; and afterwards, in Upper Loch Torridon, attains a width of 1¾ mile. Steep and lofty mountains look down upon it, two of which—Ben Liagach and Ben Alligin—attain a height of 3456 and 3232 feet respectively. The principal feeders of Upper Loch Torridon are the Torridon, which flows into its head, and the Balgay, which issues from Loch Damph and falls into its southern side. The former of these streams runs out of Loch-an-Aisgich, so named from its abounding in fish.

Obstructions on Amhain Thrail.

Shortly after reaching Loch Torridon I proceeded to inspect the Amhain Thrail, the principal tributary of the Torridon, which flows out of a mountain lake nearly a square mile in extent, and after a course of about 3 miles joins the Torridon near its mouth. There are several natural obstructions in the course of this stream, and Lord Lovelace, to whom it belongs, and who is proprietor of the estate of Ben Damph on the south shore of Loch Torridon, is anxious to make these obstructions passable, so as to allow of the ascent of salmon into the loch from which it flows. I accordingly carefully inspected the whole course of the stream, in company with the head keeper at Ben Damph, from its junction with the Torridon up to its parent loch.

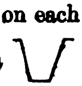
Near the junction of the Thraill with the Torridon, the water at the mouth of the former was rather dead and still when I visited it, whereas there was a strong stream in the Torridon. It would, I think, be advisable to narrow the mouth of the Thraill in order to increase the rapidity of the current, as a brisk stream is more attractive to salmon than still water.

The Thraill has a course about 3 miles from Loch Nam Fiad to its junction with the Torridon. The loch is 586 feet above the level of the sea, so that the river has a fall of nearly 200 feet per mile; and the effect of this precipitous descent is that it runs out very soon after a flood, and remains in good angling condition for but a short period.

I am inclined to think that it would greatly improve the angling in the Thraill if an artificial loch were formed not far from its junction with the Torridon, at a point where there are two large boulders just beneath the lower end of a small island in the stream. Here a dam of stones or concrete might be constructed across the river, so as to form a small loch, probably about 7 or 8 acres in extent, which would serve as a lie for salmon and sea trout. This might be done without incurring much expense. But it would certainly cost a very considerable sum to open up the falls and rapids which intervene between the mouth of the Thraill and Loch Nam Fiad; and it seems to me very doubtful whether the result, in the shape of improved angling, would be such as to repay the outlay.

The first natural obstruction which entirely prevents the ascent of salmon is a long rapid, somewhat less than a mile above the mouth of the river. At present there are several straggling and disconnected streams pouring over the face of the rock. These should be united and concentrated on the left bank, and several resting pools should be formed, in order to enable fish to rest and recruit in the course of the long ascent they have to make. The Ben Damph keeper, who accompanied me during my inspection, is quite able to explain my views of what ought to be done in the event of its being decided to attempt to make this rapid passable for salmon.

About a third of a mile above this rapid there is a water-fall, which is a very formidable obstruction. It is at least 18 feet high, with perpendicular walls of rock on each side of the chasm below the fall. There is a long, deep, dark pool beneath the fall, which would likely be a favourite lie for salmon if they were enabled to reach it. It would, however, cost a large sum to make this fall passable. A plan has more than once occurred to me when examining such falls as this, where there is a lofty and totally impassable obstruction, with perpendicular walls of rock hemming in the chasm on each side of the pool below the fall. It is as follows:—

Construct a  shaped wooden shoot, extending from the water above the fall along one of the perpendicular walls of rock to the pool below. This should be supported on iron struts fixed in the rock, and the gradient should not be steeper than 1 in 10 or 11. The flatter the

gradient the better. Narrow pieces of board might be nailed at intervals on each side of the wooden shoot. The bottom of the shoot where it enters the pool should be somewhat wider than the top of it above the fall. I should state that this plan has never been tried, and might not prove successful. But it is quite clear that if it did succeed, it would be very much cheaper than making a fish-pass by blasting the solid rock.

But the obstructions on the Thraill do not end with this fall, for there is still another impassable obstacle before we reach Loch Nam Fiad. This consists of a waterfall, not so formidable as that immediately below it, but still, as it stands, presenting an absolute barrier to the ascent of salmon. If it is to be made passable, I would venture to recommend the construction of a subsidiary dam, about 4½ feet high, beneath the lower branch of the fall, and a good deal of cutting would also be required in the upper branch of the fall on the left bank; I am clearly of opinion, however, that it would not be worth while to incur the expense that would be required to make all the impediments on this rapid mountain stream passable for salmon. But the loch near the mouth might possibly be formed, and the rapid, which is the lowest of the obstructions, might be made accessible by the means I have already recommended, so as to allow salmon to ascend as far as the long, deep, dark pool at the foot of the perpendicular fall above the rapid, for a much less sum than it would require to overcome all the obstructions so as to allow salmon to have free access into Loch Nam Fiad.

The Balgay River and Falls.

I afterwards carefully inspected the Balgay river and falls. The Balgay has a short course of somewhat more than a mile, issuing from Loch Damph and flowing into Upper Loch Torridon. It has a very small drainage area—only about 9 square miles. Loch Damph is encompassed by lofty and picturesque mountains. It is nearly 4 miles long, with an average width of half a mile, and some of its feeders have excellent spawning ground.

There can be no doubt that previously to the passing of the Salmon Fishery Acts of 1862 and 1868, the rod fishing for salmon in the Balgay, Torridon, and other rivers flowing into Loch Torridon, was very much better than it is at present. In his memorandum on the decay of the salmon fishings in the rivers flowing into Loch Torridon, which is dated 23d December 1884, and which is published in my third Report on the Salmon Fisheries of Scotland, Mr Darroch of Torridon writes as follows:—'The river Balgay and Torridon, with Loch-an-Iasgaiche, have been 'noted salmon waters from time immemorial, so much so that in deed 'after deed from the year 1624 they have been specially conveyed by 'name; the half of the fishing of the short river Balgay even being thought 'in 1624 worthy of being split into two further equal parts between the 'representatives of the two heirs portioners of Donald of the Isles; and 'it is the fishing of these waters, so jealously guarded for hundreds of 'years, which has been wrested from the Crown grantees by the fixed nets 'authorised by the Act of 1862. The fishings of the Balgay were valuable 'enough to induce the late Sir John Stuart to go to law with Colonel 'M'Barnet, late of Torridon, for their exclusive possession, and that too, 'not only through all the Scotch Courts, but even up to the House of 'Lords. There is ample evidence of the fishing having been most productive 'during the early part of this century, and fairly so up to about 1863.'

The subsequent falling off is generally, and I think justly, attributed to the estuary line fixed by the Commissioners of Scotch Salmon Fisheries. The bye-law fixing this took effect from 11th March 1865. The estuary for the Torridon, Balgay, and Shieldag is thereby defined to be 'a straight 'line drawn across the Narrows between Loch Shieldag, and outer Loch

'Torridon, where Diobaig Point and Ru Ardtishlic most nearly approach 'each other.' This line is 7 miles within the mouth of Loch Torridon, where it contracts to a width of three quarters of a mile, so that the fixed nets immediately outside that line intercept the great majority of the salmon seeking to ascend the rivers that fall into Loch Torridon. Mr Darroch states that this estuary line was fixed in the absence of the river proprietors, that its effect has been 'to deliver over the gate 'leading to their fisheries to intercepting fixed engines,' and he maintains that the natural estuary for Loch Torridon, as any one may see on consulting the map, is from Red Point on the north to Ru Uamh on the south, or a line about 7 miles outside that fixed by the Commissioners. But the evil is done; and there is no power under the existing Acts to alter and amend estuary lines. Possibly it might pay the river proprietors above the present estuary line to lease these fixed nets outside the estuary, and work them, in order to repay their outlay to some extent, for four days in the week—say from Monday morning until Friday morning—which would leave a three days' weekly close-time for the fish to reach the rivers, instead of only thirty-six hours as at present, which, it is alleged, is very imperfectly observed by the occupiers of the nets in question.*

Falls on the Balgay.

On the river Balgay, between Loch Damph and Loch Torridon, are falls, which are at present a most serious impediment to the ascent of salmon and sea trout, though they do not constitute a complete barrier. It would, however, be neither difficult nor expensive to make them easily passable, either on the right or on the left bank. Indeed, it would be much more easy and much less costly to make these falls accessible than to make any one of the three obstructions on the Amhain Thraill passable for salmon. If the operations are to be made on the right bank, the best plan would, I think, be to divert the water temporarily to the left bank, to blast out the top of the fall on the right bank, make a resting-pool between the top of the fall and the pool at the bottom, and widen the opening from the pool on the right bank to the pool on the left bank.

I rather incline to think, however, that the better and cheaper plan would be to utilise and take advantage of a sort of natural salmon-ladder which goes quite round the falls on the left bank, and which does not require much alteration to make it into an efficient fish-pass. Some boulders would require to be removed and some resting-pools formed, and, in one or two places, a little deepening and widening might be advisable, and perhaps a little blasting at the top. But all this might be accomplished for a moderate outlay, to the very great improvement of the salmon angling in the district. The Balgay, between the top of the falls and the lower extremity of Loch Damph, is only about a quarter of a mile long, and it runs through a rocky gorge in which there is a good deal of turbulent and broken water, but nothing to stop salmon if they were enabled easily to ascend the falls.

There is a point of some importance in connection with the opening up

* The evidence given in the case of 'Stuart *v.* M'Barnet' conclusively shows what a productive river the Balgay was up to at least 1863. George Mackenzie, 83 years old, stated that, in the old time, they used to get eight or nine salmon in a night poaching, and remembers a new net broken by the weight of the fish in the mouth of the river. Fifty salmon were caught on that occasion. William Cameron, farmer, lived twenty-six years near the mouth of the Balgay. When he first went there, gentlemen used to get six or seven fish a day with the rod; now a man may be days and get none. Alexander Chisholm, Keeper to Sir John Stuart, said that he fished the mouth of the Balgay from 1861 to 1863 with net and coble, and caught as many as 400 to 600 salmon, including grilse, in a season. Now from twenty to thirty salmon at the outside are caught in the Balgay during a favourable season, and in a dry season nothing like that number.

of the falls of the Balgay, and it is this—Will salmon and sea-trout run right through Loch Damph to its feeders and the smaller lochs above, or will they remain for some time in the spacious waters of Loch Damph? My own opinion is—though it is scarcely possible to speak with certainty on the subject—that if the falls were so dealt with as to offer but little obstruction to the passage of salmon, a good many of them would remain, for a time at least, in Loch Damph, especially in the earlier part of the season; though, when the spawning time approached, their sexual instinct would naturally lead them to ascend to the upper waters.

It is somewhat difficult to say, with any degree of certainty, whether or not salmon would take the fly or the minnow freely in Loch Damph, in the event of their having easy access to its waters. In Sutherland, there are some lochs to which salmon have easy access, but where they will take neither the fly nor the minnow; whereas in others in the same county, such as Loch Laxford, Loch Garbet-beg, Loch Achnahu, Loch Dionard, Loch Slam, and others, they take the fly freely; and, in Caithness, Loch More is one of the best beats for fly-fishing on the Thurso, as many as twenty-one salmon having been killed on it in a single day. Then there are some lochs, such as Loch Tay, and Loch Shiel, which stretches for 24 miles between Inverness-shire and Argyllshire, where salmon take the minnow greedily, but will scarcely look at a fly. In short, this question is one that can only be answered by experience.

*Claims of the Crown.*—If the falls on the Balgay had been absolutely impassable, so that no salmon or sea-trout had ever ascended into Loch Damph and its tributary streams, and the proprietors interested had made them passable, and so created *an absolutely new salmon fishery*, there is little doubt that the Office of Woods and Forests, as representing the Crown, would have a claim on the new salmon fishery so created. But from what I heard when at Ben Damph in July last, it seems quite clear that no such claim could be legally made and maintained in the event of the falls of the Balgay being made perfectly accessible for salmon, as it can be shown and proved that sea-trout—which are included under 'Salmon' in the interpretation clause of "The Salmon Fisheries (Scotland) 'Act, 1862'—have been captured in Loch Damph and the smaller lochs above it, also that a kelt salmon was taken in Loch Damph, and that parr have frequently been seen in Loch Damph and its feeders. Any claim, therefore, made by the Crown consequent on the thorough opening up of the falls of the Balgay could not be sustained, because no new salmon fishery would be created, but only an already existing fishery would be greatly increased and developed.

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**Annan and Nith Districts.**

In the end of last July, by direction of the Board, I made an inspection of the Fishery Districts of the rivers Annan and Nith. On the 24th July, along with Mr Johnstone Douglas, Chairman of the Annan District Board, I visited Newbie lade, a most objectionable lade more than half a-mile long and from 12 to 30 feet wide, the latter width being at the intake into which the chief stream of the river goes. There is no heck at the intake and none at the tail-lade, though there is one at the wheel. The tail-lade runs into the river, with a strong current occupying two-thirds of breadth of the bed, so that salmon would naturally take the tail-lade in preference to the comparatively still water of the river. In fact, Newbie lade is admirably calculated to act as a salmon trap, and to facilitate poaching. A heck should certainly be put on the tail-lade in terms of the Bye-law (Schedule G), and one should also be placed at the

intake; and this might be done, in spite of its great width, by putting two iron posts in the lade, with slots or grooves on their sides, so that a portion of the heck might be withdrawn in case of floods, and so the pressure of the water diminished.

I visited this lade in 1883; and in my second Annual Report to the Board I write about it as follows:—'The dam and lade at Newbie Mill 'are not constructed and worked in terms of the bye-law regulating the 'construction and alteration of mill-dams, or lades or water-wheels, so as 'to afford a reasonable means for the passage of salmon, in so far as hecks 'are concerned.' There has been no improvement, no attempt to comply with the provisions of the bye-law, since the above was written.

Paidle-nets on Blackshaw Bank.

I was informed by the Chief Constable and Superintendent Pool that the paidle-nets, about which there has been so much controversy and litigation, and which have been again and again condemned as nets set up and used for the taking of salmon by Courts and Commissions, have been re-established on Blackshaw Bank in spite of Lord Trayner's Interlocutor of 10th December 1886, which declared them to be illegal, and ordered their removal. There are not, however, as many of them as when I visited the Nith District in 1883. I found the leaders of those I examined in July last to be from 4 to 5 feet high, and there was only an ebb arm. Some of them were in fishing order.

Evidence with regard to Paidle-nets before Special Commissioners in 1878.

A great controversy has arisen and been carried on with a good deal of acrimony as to whether these paidle-nets do or do not catch salmon. But the recent though somewhat tardily published evidence* taken by the Special Commissioners appointed under the Solway Salmon Fisheries Commissioners (Scotland) Act, 1877, to 'inquire into the legality of all 'fixed engines erected or used for the taking of salmon in the waters 'and on the shores of the Solway Firth in Scotland, as the same have 'been fixed under the authority of "The Salmon Fisheries (Scotland) Act, '"1862," and in the rivers falling into the same,' conclusively shows that, at the time of the Commissioners' visit, and for many years previously, these paidle-nets had taken salmon, not merely occasionally, but frequently, and in considerable numbers. Accordingly, the special Commissioners were quite clear that the paidle-nets were engines erected and used for the purpose of taking salmon, and they ordered to be removed such of them as they had seen at the time of their visit to Annan; and, on appeal, the Second Division of the Court of Session, without looking at the evidence, declined to interfere with the deliverance of the Commissioners, who, they held, had a clear statutory duty which they were bound to perform. It is worth glancing at some of the evidence laid before the Commissioners respecting these paiddle-nets. Mr David Poole, Superintendent of the Constabulary at Dumfries, says: 'The paidle-net 'has been called a white-fish net by the people who fished it, but it is one 'which will quite as well take salmon. It is erected in nearly identically 'the same manner as the salmon stake-net. In so far as the character of 'the ground is concerned, these nets occupy precisely the same position 'as the salmon stake-nets, or nearly the same position. At all events, it 'is ground calculated for the catching of salmon and within the run of 'salmon.' Afterwards he says: 'I have very often seen salmon caught in 'them. I have seen eight salmon alive in one pocket. In that case, 'when we were waiting to see what was in the net, the man went with 'his knife and ripped the bottom of it. How many were in before I 'don't know.' Again he says:—'In 1869, 1870, and 1871, I was 'present at every one of the prosecutions. Some of them were for fishing 'during the annual close-time with paidle-nets. Others were for fishing 'during the open season, and catching salmon with paidle-nets. All those in

* The evidence was taken in 1878, but was not published until 1891.

'1871 were for fishing during the open season and taking salmon in their 'nets without leave of the proprietor of the salmon fishings. Every one of 'the prosecutions relates to the paidle-nets. The convictions were all for 'actually taking salmon.' Being asked, 'Whether fish of the salmon kind 'can be caught in the close-time?' Mr Poole answered:—'I can't say what 'it is in Annan now, but for some time after I first came here you could 'have got them by the hundredweight at 3d. per pound in the close-time. 'Both paidle and poke net fishing went on at that time.' John Ferguson, Constable in the Cumberland Police Force, who was employed as water-bailiff in Annan from 1876 to 1878, states:—'I patrolled part of the river 'Annan and part of Newbie shore from Annan water-foot to Lochar-'foot on Mr Beattie's Newbie Fishery. There were paidle-nets there 'from the Flag-scaur to Newbie, including the Pow-foot Scaur, where 'the most of them were. John Gilbertson had a net there, just down 'nearly opposite the village of Pow-foot, in 1876 and 1877. I saw sea-'trout in that net on the 16th of April 1877, and there were two trouts 'in it on the 10th of May 1877. I saw nine salmon—seven alive and 'two dead—in William Coulthard's paidle-net on the 1st of May '1877.' John Forteith, Constable at Glencaple on the Nith, says:—'I knew that these nets caught salmon; I have very often seen salmon 'in them—as many as seven in one net.' Walter Thorburn, an Inspector in the Dumfries Constabulary, on being asked 'Do you think 'the name "white fish net" gives a proper description of the paidle-'net?' replies:—'"Salmon-net" is the appropriate description; they 'catch both. If the fishers were only allowed to catch white fish, so 'many of them would not fish at all, because it would not pay any 'man. Flounders are very scarce in the Solway now, and there are 'not many codlings.' Robert Thomson, for a long time foreman to Mr Beattie of the Newbie Fishery, says:—'They (the paidle-nets) have had 'covers to the pockets ever since I knew them; they were just the same 'as salmon nets in that respect. They were suitable for catching salmon 'as well as flounders. I have very often caught salmon in them, and 'more than one at a time. Two was a gey common thing, and we might get 'three or four, depending on the different tides. I once got seven at one 'tide in one paidle-net.' Lastly, John Wilson, a fisherman, 76 years of age, says on being asked 'Did you catch any salmon with the paidle-nets?' 'I would not have kept them in unless I could make wages at them, and 'I would not have got out of bed for all the flounders I got. In former 'times, the first nights of my fishing I killed a great quantity of flounders, 'from 18 to 20 stone at a time; but after the boats came on they destroyed 'the white fishing. I would not work any at all without the salmon, if 'I could help it. The salmon would keep me perfectly well without 'working the time I had my net on; the flounders would hardly keep 'the cat; they are very scarce in the Solway now.'

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The pool-and-jump pass on the Cauld at Dumfries is so close to the bank that anyone could throw a leaded treble hook into it when salmon are running, though it is, to a certain extent, protected by a wall and railing. Apart from this objection, it is an efficient ladder; though perhaps the pool beneath the lowest jump might advantageously be deepened; also a sort of natural channel in the rock, leading from near the top of the ladder towards the right bank, might likewise be deepened. Pass on Dumfries Cauld.

A complaint was made to me at a meeting of the Nith District Board that the lessee of the mill which is supplied with water from the dam formed by the Dumfries Cauld is in the habit, whenever there is a lack of water for his mill, of putting a board across the cut in the crest of the

Cauld through which the water runs into the fish-pass on the left bank and so entirely preventing the ascent of salmon into the upper waters. In the ordinary case, such a proceeding would be utterly illegal and in distinct violation of the 6th section of the bye-law (Schedule G). But it was stated to me that in this case the municipality of Dumfries, from whom the miller holds his lease, have a title fortified by prescription, which exempts them from the provisions of the above-mentioned bye-law. It seems to me that the town can only claim such an exemption under the provision at the end of the 6th section of the Salmon Fisheries Act of 1862, that the regulations made by the Commissioners 'shall not interfere with any rights 'held at the time of the passing of this Act under royal grant or charter, 'or possessed for time immemorial.' But I venture to think that, even if the town can show that their title is covered by this proviso, it will not entitle them or their lessee to block up the fish-pass in defiance of the bye-law (Schedule G). For the decision in the case of 'Kennedy *v.* Murray, '8th July 1869' seems to authorize the view that the Commissioners regulations embodied in the bye-law are valid and binding in spite of the proviso. It was there held (1) 'that the Salmon Fishery Commissioners 'under the Act of 1862 have power to make bye-laws applicable to lades, 'dams, &c., whether in the process of being constructed or repaired or not; 'and (2) (by a majority of seven judges, the Lord President, Lord Justice-'Clerk, and Lord Cowan dissenting) that the Commissioners have also 'power to impose an obligation on the owners and occupiers of mills to 'execute at their own cost the works embraced in the bye-laws so made.'

Pollution of the Nith.

There is no diminution in the pollution of the Nith since I inspected it in 1883; and it is still made the receptacle for the sewage of Dumfries, and the polluted and poisonous water from the mills and manufactories on its banks. The consequence is that the bed of the river in many places between the Cauld and the sea is a mass of fœtid mud, as I can testify from personal observation, and the salmon fishings have greatly fallen off. And unfortunately, as the law at present stands, District Boards are powerless to deal with the evil. They cannot travel beyond the Acts which create them and define their powers, and cannot, therefore, prosecute at common law, as riparian owners may do. Consequently, they can only act upon the 13th clause of the Salmon Fisheries Act of 1862, as amended, or rather emasculated, by the 16th section of the Act of 1868. That 13th section provided that 'every person who causes or knowingly permits to 'flow, or puts or knowingly permits to be put, into any river containing 'salmon, any liquid or solid matter, poisonous or deleterious to salmon, '*or who shall discharge into any river sawdust to an extent injurious to* '*any salmon fishery*, shall be liable to the following penalties,' &c. Under this section it was sufficient, for the purpose of procuring a conviction, to prove the discharge of liquid or solid matter poisonous or deleterious to salmon into any river containing salmon. But the amendment introduced by the 16th clause of the Act of 1868 strikes out the words '*or who shall discharge into any river sawdust*,' the putting of sawdust into rivers being separately provided against by paragraph 7 of the 15th section of the Act of 1868; but then it unfortunately leaves in the words, '*to an extent injurious to any salmon fishery*,' which evidently belong to and were meant to be read in connection with the words, '*or* '*who shall discharge into any river sawdust*,' and which ought, therefore, to have been struck out at the same time. As it is, they have been allowed to remain, and now read in connection with the words, '*any* '*liquid or solid matter poisonous or deleterious to salmon*;' and the consequence has been that while, under the Act of 1862, it was sufficient to prove the simple putting in of matter poisonous or deleterious to salmon

into any salmon river, you must now, under this falsely-named amendment of the Act of 1868, not only prove this, but prove in addition that it was put in '*to an extent injurious to any salmon fishery*,' which opens up an endless field for litigation, and makes it almost hopeless for District Boards, when opposed by rich manufacturers, to procure a conviction for the pollution of rivers. The remedy for this unsatisfactory state of matters is, it humbly seems to me, to enact a clause something like the following in any future Salmon Fishery Act:—'Section 13, of the recited 'Act 25 and 26 Vict. cap. 97, and section 16 of the recited Act 31 and '32 Vict. cap. 123, are hereby repealed, and it is hereby enacted that 'from and after the passing of this Act, each District Board, within its own 'district, shall have and possess the same powers of prosecution for the 'prevention and abatement of pollutions in rivers and waters as are at 'present competent to individual riparian owners in such district.' Possibly County Councils may be able to deal with the increasing evil of the pollution of rivers; and if so, their action will be most salutary and beneficial, especially in the numerous Fishery Districts in Scotland where there are no District Boards.

The following precognitions of two tacksmen of salmon fishings, taken by the Clerk to the Nith District Board, will show the terribly deleterious effects of pollutions and whammel-nets on the fishings in the Nith between Dumfries Cauld and the sea.

DUMFRIES, 14*th August* 1891.

Charles Turner, Fishmonger, Dumfries, aged 41, residing in St Michael Street there, says:—

I and my brother George Turner, Turner's Terrace, Maxwelltown, are tacksmen of the salmon fishings in the River Nith, from the Cauld at Dumfries to the Granite Stone on Netherwood Merse. We have held these fishings for the last four years.

Our first year was a bad one.

During the second year we made what enabled us to recoup the loss on the first.

Last year rather more than paid expenses.

This year we have realized £75, to meet £250, with only three weeks of the season to run.

In my opinion the fishings are gradually becoming worthless, and I attribute this to two causes (*First*), the whammel-nets in the Solway and estuary, and (*Second*), the pollution of the river by the effluents from the mills and the town sewerage.

I must admit that in a wet season the fishing is better than in a dry, and that the present has been a very dry season, but in a dry summer, when the river is low, the sewage and poisonous effluents have greater effect on the small body of water.

When the water is low, I consider the pollution the sole cause of deterioration. Scarcely a fish will run up.

During six weeks of this season we stopped fishing altogether, with the exception of an occasional trial without our full strength of men, just to see if any fish were running. We generally made these trials as soon after six o'clock on a Monday morning as possible, so as to get in before the refuse was discharged from the mills, and we generally got a few trout.

When the fish have been up the river I have seen them at the ford at the New Quay making back to the sea on Monday mornings after meeting the refuse from the mills.

The dyes are plainly seen in the water. They are seen of various colours at different times—black, violet, drab, and at Castle Dykes I have seen several colours at one time. During the six weeks I have mentioned, when the water was low, I have seen it black from bank to bank—so black that a piece of white paper could not be seen a foot deep, and between the sewage and mill effluents the smell is so bad that I could compare the river to nothing but a stinking canal.

I am further of opinion that the town sewage, when the water is low, has filled up the salmon pools. The 'Hole of the Wood' and 'Round Pool' are now quite level, and others are nearly filled up. When drawing our nets in these latter they are literally closed up with stinking dirt.

The other great cause of deterioration of the fishings is the whammel-nets. They come as far up the river as the southmost house at Kenneth Bank, and when stretched across the stream scarcely a fish can get past them. These whammellers have licenses from Mr Adam Edgar, the tacksman of Arbigland Fishings. It is only these who come so-far up the river. They are the worst, but others who whammel more in the channel of the Solway are bad enough. The nets are floated up and down with ebb and flow, and little escapes them, and it is not only what they take, but fish coming in contact with them turn and fly seawards.

(Signed) CHARLES TURNER.

DUMFRIES, *14th August* 1891.

John Turner, Kelton Bank, Dumfries, aged 33, says:—

My father, Robert Turner, Fish and Game Dealer, Castle Douglas, and I are joint-tacksmen of the salmon fishings at the estuary of the Nith, belonging to Mr Maxwell Witham of Kirkconnell.

This is our fourth year on Kirkconnell Fishings.

The fish have been getting scarcer every year during our tack. They have been dying in considerable numbers.

At first it was the month of June before we began to find dead fish, but last year we found them dying in the last week of April.

The fish come up with the tide, and after the ebb, if they happen to be left in a pool, they become sickly and float on their sides, and after a little we can see them waggle, turn up their bellies, and die in a minute or two.

I attribute this to the pollution of the river by the dye and other poisonous and deleterious substances which come from the mills and factories at Dumfries.

The pollution from this source appears to have increased during the last few years.

When the mills are stopped on Sundays, the water becomes quite pure, and I have never seen any dead fish in the river on a Monday morning.

During the dry weather there were some dead fish found every day. The people at Glencaple and Kelton make a practice of going up and down the river-side when the ebb begins, looking for the dead fish, which they either use or sell.

The fishings are getting much worse every year, and if something is not done to prevent the pollution, they will soon be so poor that they will not be worth fishing.

I am not aware if the dye is let off from the mills every day, but at any rate it is much worse some days than others. Where the water is stagnant or sluggish we can see it quite blue—almost black—with the dye, and when we come out of the water, after wading, we find our leggings of a mauvish colour at the water-mark.

I have seen a sheet of dye—a kind of scum—6 feet in diameter and 6 inches thick above water, coming floating down the river.

(Signed) JOHN TURNER.

Paidle-nets at Annan, Pow-foot.

At Annan, Pow-foot, there are several paidle-nets which I inspected. They have leaders, the stakes of which are about 5 feet 6 inches high, and pockets like those of a fly-net. I was informed that the codlings and flounders caught in these nets bring but a very small price, namely, 10d. per stone for codlings and 1s. per stone for flounders. It was low water when I inspected these paidle-nets. At this part of the Firth there is a great extent of muddy foreshore, and some of the paidle-nets are placed quite close to the low-water channel of the Firth. Here there is a very large portion of the foreshore—I should think at least a square mile—

thickly covered with mussels, mostly immature, and seldom exceeding an inch in length—the quantity of soft mud probably preventing their proper growth and development. I noticed also two species of clams. Considering how valuable mussels are for bait, and how many of our Scotch mussel beds have been ruined by improvident fishing, one cannot help regretting that the vast quantity here lying useless could not be removed to some locality where they would grow and thrive. But I am afraid that no such locality is to be found nearer than Wigtown Bay.

Whammel-nets and their injurious effects.

While I was inspecting these paidle-nets a boat fishing for salmon in the low-water channel of the Firth with a whammel or hang-net—the most destructive and objectionable of all moveable nets—came so close to the Scotch shore that I could have thrown a stone into her. These whammellers have no title whatever to fish for salmon on the Scotch side of the Firth, nor have they permission from any one who has a title. Anywhere else in Scotland they could be stopped at once, and their owners prosecuted and punished under the 7th and 8th Vict. cap. 95, entitled 'An Act to amend an Act of the 9th year of King George the Fourth for the 'Preservation of the Salmon Fisheries in Scotland'—which provides that 'whereas it is expedient to prevent the destruction of salmon, or fish of 'the salmon kind, in the sea or shores thereof; and whereas doubts are entertained of the provisions of the said Act being applicable to the sea 'or seashore, Be it therefore enacted, &c., that if any person, not having 'a legal right or permission from the proprietor of the salmon fishery, shall 'from and after the passing of this Act, wilfully take, fish for, or attempt 'to take, or aid or assist in taking, fishing for, or attempting to take in or 'from any river, stream, lake, water, estuary, firth, sea-loch, creek, bay, or 'shore of the sea, or in or upon any part of the sea within one mile of 'low-water-mark, in Scotland, any salmon, grilse, sea-trout, whitling, or 'other fish of the salmon kind, such person shall forfeit and pay a sum not 'less than 10s. and not exceeding £5, for each and every such offence, and 'shall, if the Sheriff or Justices shall think proper, over and above, forfeit 'each and every fish so taken, and each and every boat, boat tackle, net, or 'other engine used in taking, fishing for, or attempting to take fish as afore- 'said: and it shall be lawful for any person employed in the execution of 'this Act to seize and detain all fish so taken, and all boats, tackle, nets, 'and other engines so used, and to give information thereof to the Sheriff 'or any Justice of the Peace, and such Sheriff or Justice may give such 'orders concerning the disposal of the same as may be necessary.' This Act is amended and made more stringent by the 25th section of 'the 'Salmon Fisheries (Scotland) Act, 1868,' which gives ample powers of search and seizure to constables, river watchers, officers of District Boards, &c., and declares that the possession of salmon by unqualified persons shall be held *prima facie* evidence of their intention to contravene the provisions of the 7th and 8th Vict. cap. 95. Unfortunately, neither this Act nor its amendment apply to the Solway Firth, because the 25th section of the Act of 1868 is an amendment of 7 and 8 Vict. cap. 95, which again is an amendment of 9 Geo. IV. c. 39, the 14th section of which excludes the Solway and the rivers flowing into it. Nothing would do more to improve the Salmon Fisheries in the Solway Firth than the repeal of this exclusion, which would enable the District Boards of the Annan and Nith, which suffer most from the ravages of these 'whammellers,' to prosecute and put them down. At present, they cannot raise a prosecution with any chance of success, although these men annually capture tons of salmon in the low-water channel of the Firth, and greatly injure the fisheries in the rivers both on the Scottish and English sides of the Solway.

Evil effects of Hang-nets on the Tyne.

I have twice visited the Solway Firth as a Government Commissioner —in 1870 and 1880—and have twice carefully examined its Fisheries since my appointment as Inspector of Scotch Salmon Fisheries in 1882; so that I have had ample opportunities of studying the various questions that arise from its peculiar position, its exceptional physical features, and the variety of Acts of Parliament that apply to it. And I have no hesitation in expressing a decided opinion that nothing has done so much harm to its salmon fisheries as these hang or whammel nets which float like a wall of netting in the narrow and comparatively shallow low-water channel of the upper part of the Firth, stretching almost entirely across it, and intercepting the majority of the fish which are making for the rivers. That these nets are most prejudicial in rivers and in narrow channels has been repeatedly shown. In four years they nearly ruined the fishings in the Northumberland Tyne. In the official Reports of the late Mr Buckland and of Mr Spencer Walpole, it is stated that 129,000 salmon were captured in the Tyne in 1872, and that there was even a larger take in 1868. In 1866, hang-nets were introduced, in small numbers at first; but year by year their number was increased, until at last hundreds of such nets, many of them of great length, might have been seen at night fishing for salmon in the sea north and south of the mouth of the Tyne. The evil effect on the fisheries was soon apparent. On a fishing 2 or 3 miles below Newcastle, 1252 salmon were taken in 1867, and only 226 in 1873; while on a fishing immediately above Newcastle, where the lessee made £1500 in 1867, the take fell to only 36 salmon in 1873.

The general result to the Tyne fishings was most disastrous. In 1872, 129,100 salmon were taken, while in 1874 only 21,746 were captured, or, in other words, only one-sixth of the take of 1872. The salmon are in the habit of congregating in large numbers behind the two solid masonry piers which have been constructed by the Tyne Navigation Commissioners, north and south of the entrance of the Tyne. The neighbourhood of these piers formed the most convenient places for the operation of the hang-net fishermen, and thousands of salmon were annually taken there.

In 1873, however, a new Salmon Fishery Act for England was passed, and under the powers conferred by it, the conservators of the Tyne drew up a bye-law prohibiting any netting for salmon within a certain distance of the piers at the mouth of the Tyne, and this bye-law was confirmed by the Home Secretary. Its beneficial effects were soon demonstrated; for whereas, owing to the operation of the hang-nets, only 21,746 salmon were taken in the Tyne District in 1874, the take in 1881 had risen to 45,946, or had more than doubled. It will be observed from the above statement that the hang-nets had not been fishing in the river Tyne itself, but in the sea close to its mouth; and it is obvious that such nets fishing in the channel of a river or in a narrow estuary, like that of the Solway at low water in the Annan and Nith Districts, would be even more deadly and destructive.

Powers to District Boards to make Bye-laws.

It would be greatly for the benefit of the Salmon Fisheries in Scotland, and would greatly strengthen the hands of District Boards in putting a stop to or limiting the operation of hang-nets, whose destructiveness has been so clearly proved, if a power of making bye-laws, such as that conferred on boards of conservators by the English Act of 1873, were conferred on District Boards in Scotland. Speaking of this part of the Act of 1873, Mr Willis Bund makes the following remarks in his book on *The Law relating to Salmon Fisheries of England and Wales, as amended by the Salmon Fishery Act of* 1873:—'Power is given to

'Boards of Conservators to make bye-laws for the better protection, pre-'servation, and improvement of the Salmon Fisheries within their 'district. This power, so long agitated for by the various Fishery Boards 'who have for some time past discovered that the varying circumstances 'of each river require special legislation to meet them, is certainly the 'most valuable provision of the Act of 1873, and one from which great 'good to the Fisheries of England and Wales may reasonably be antici-'pated.'

Another great improvement, in the event of farther legislation for the Solway, would be to empower the authorities, either in England or Scotland, to prosecute persons fishing for salmon without a right to do so in the low-water channel of the Firth, and to give authority to the Sheriffs or Justices, in any of the counties bordering on the Solway, to issue warrants to cite offenders resident in another of these counties. Owing to the want of such a power at present, it is in many cases almost impossible to prosecute and convict offenders. Powers to prosecute.

A third great improvement would be to enact that it shall be lawful for any constable or police officer, or river watcher, in any borough or place in Scotland, in any highway, street, or public place, to search any persons whom he may have good cause to suspect of having or carrying salmon unlawfully obtained, and any cart or conveyance, with power to seize and detain any fish so found, and thereafter to cite such person to appear before the Sheriff or Justices. In short, the same clause with regard to salmon should be introduced as the second clause with regard to game in the Prevention of Poaching Act of 7th August 1862, which has done more to prevent game-poaching than all the previous Acts put together. Increased powers of search for Salmon illegally obtained.

In the event of these improvements being carried out, a new clause, prohibiting unqualified persons from fishing in private waters, should be substituted for the 9th section of the Solway Act.

When I first visited the Solway, there was a very objectionable dam on the Water of Milk, one of the chief tributaries of the Annan, which entirely prevented the ascent of the migratory Salmonidæ to many miles of excellent spawning ground. I am happy to be able to report that, in the course of last year, a dam with a ladder easily passable by salmon has taken the place of the old impassable obstruction. I visited the new dam on the 30th of July last, while it was still in the course of construction, although nearly completed. I found that an apron had been put to the dam, and a pool which used to be a favourite resort of poachers had been removed. Then a ladder has been constructed on the left bank of the stream with wooden sides and stops. It has a gradient of 1 in 8, a breadth at the top of 6 feet, and at the bottom of 8 feet. The stops come about two-thirds of the way across the ladder, and in the middle there was, when I saw it, too much white water. I suggested that the sides of the ladder should be heightened about 6 inches, as by doing so a channel would be formed along the side of the ladder farthest from the left bank, up which fish would go as easily as by the ladder itself, when the water was in such a state as to induce them to run. I also suggested the removal of some smooth planks at the foot of the ladder, and the replacing them by stones, and the deepening of the pool at the foot. There are 5 or 6 miles of good spawning-ground above this dam. The Milk is more a spawning than an angling river. The fish run chiefly in September and October. Fish-pass on Dam on Water of Milk.

A very important case, arising in the Annan District, with regard to the observance of the weekly close time by owners or occupiers of fixed nets was decided by the Justiciary Appeal Court in December last. Case of Irvings *v.* Phyn.

Seven judges were on the bench, and their decision was unanimous and must be held as finally fixing the law on the subject. The case was that of Irving and others *v.* Phyn, and the decision of the Court was to the effect that the provisions of the statute and of the bye-law (Schedule D), regulating the observance of the weekly close time by stake and bag-nets, are absolute and specific, and do not admit of construction; so that no other 36 hours than those between six o'clock on Saturday night and six o'clock on Monday morning will satisfy the requirements of the statute and relative bye-law. This case reverses the decision in Osborne *v.* Anderson, in which it was held that, under certain circumstances, a tidal close time was allowable. Lord Adam, who delivered the leading judgment, said:—'The contravention in 'question took place in this respect, that these nets were not put out of 'fishing order earlier than eight o'clock on the Saturday night, the con- 'tention on the part of the respondent being that, upon a sound con- 'struction of this clause, they were bound to have been put out of fishing 'order at six o'clock. The answer to that was that the state of the tide 'at six P.M. was such that the nets could not be put out of fishing order. 'He thought the words of the statute were as clear as words could be 'when it was enacted that the weekly close time should continue from 'the hour of six o'clock on Saturday night to six o'clock on Monday 'morning. He did not think the requirements of the section could be 'met by adopting any other hours than those stated, and, indeed, that 'the language of the section was not capable of construction. The 'operation of that might be, as apparently it was in some cases, to 'operate so as that it should continue longer, but still the Act was quite 'clear in saying that the close time should continue during that time. 'He did not think the Court was entitled to consider whether or no 'difficulties might arise. In his opinion, the Act was not open to 'construction, and, notwithstanding the case of Osborne, which had 'been quoted, and which he thought was wrongly decided, the sound 'construction of the Act of 1862 was that the close time should run from 'six P.M. of Saturday to 6 A.M. of Monday.'

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Artificial Obstruction on the River Truim.

On the 19th of November last, by direction of the Fishery Board, I met Mr MacGregor, Superintendent of the Spey District Board, at Kingussie, with the view of inspecting an alleged illegal artificial obstruction in the bed of the Truim, an important spawning tributary of the Spey.

The Truim rises in the Grampians, near the Perthshire border, at a height of 2100 feet above the level of the sea, and then runs 15½ miles north-northeast, till, after a descent of 1280 feet, it falls into the Spey at Invernahaven, 6 miles southwest of Kingussie.

After leaving Kingussie, we drove to Truim Bridge, and then walked up the right bank of the Truim till we reached the obstruction complained of by the Spey District Board. This is situated about half-way between the falls of the Truim and the junction of the Truim and the Spey. It consists of a pretty solidly built artificial dam, nearly 6 feet high, on the down-stream face, beginning on the Belleville, or right bank of the Truim, and extending 43 feet across the stream towards the Glentruim or left bank. This dam has the effect of deepening the pool above, and creating a pool and a lie for salmon below it, from which they may easily be taken out by fair means or foul. At the Glentruim end of the dam there are natural rocks in the channel; and between these rocks and the left bank of the river there is a narrow and comparatively shallow stream, about 12

feet wide, still unobstructed; whereas the artificial dam and the rocks to which it joins on entirely block up a space of 49½ feet. In addition to the dam being substantially built of piles and tree-trunks and stones, it is still further strengthened and bound together by railway metal rails running along its crest, and by two iron struts supporting the down stream face. I have little doubt that when the river is in such a state as to induce fish to run—and it was just in such a state when I inspected it—that such fish, instead of taking the narrow channel on the left bank, will find a resting-place in the pool below the artificial dam; and I think there can be no doubt that spawning fish will not ascend to the valuable spawning beds higher up with anything like the same ease that they could do before the obstruction was erected and the natural course of the river interfered with. The present obstruction serves no industrial purpose. It is not in connection with a saw or a corn mill. It is an obstruction, pure and simple; and, as such, I think it might be removed by an action of Declarator and Removal, or other process of law.

In several places in his *Treatise on the Law of Scotland relating to Rights of Fishing*, Mr Stewart distinctly states that obstructions like that in the Truim are illegal. Thus on p. 141 he writes: 'In a private 'stream a person who is proprietor of the fishings, and also of one of the 'adjacent banks, is entitled to make such use of the bank for the purpose 'of fishing or otherwise, as he may think proper. But his power is sub-'jected to the important limitation, that no erections which he may 'make, and no operations which he may carry on, shall have the effect 'of altering the flow of the stream, to the possible damage of the 'opposite proprietor. The proprietors upon the opposite banks of a 'private river have a common interest in the stream, and though each 'has a right of property in the *alveus* from his own side up to the '*medium filum fluminis*, neither is entitled to use the *alveus* in such a 'manner as to interfere with the flow of the stream. Erections on the 'bank which do not impinge upon the water cannot be objected to; 'but the slightest encroachment upon the stream may be resisted and put 'a stop to without the necessity of proving that damage has been likely 'to be sustained, for it is impossible to foretell what the result of it may 'be on the course of the river. And, for the same reason, if any ob-'jection be taken, the onus of proving that the act is not an encroach-'ment falls on the party making such encroachment, who is, *prima facie* 'held responsible.' On page 159 he further writes:—'Obstructions, 'whether partial or total, have always been found to fall under the pro-'hibitions; and no kind of barrier to the progress of the fish, whether it 'rise above the surface of the water or not, will be permitted. It has 'even been found that placing a row of loose stones, not of any consider-'able size, in the bed of a river, not across it, but merely upon the edge 'of a pool to facilitate fishing by net and coble is illegal, though net and 'coble is the ordinary and legal mode of fishing; the prohibitions extend 'also to all practices, either destructive to the breed of salmon or so 'noxious to their tastes and instincts to deter them from ascending 'higher than suits the interests of the party using such practices.' (See also Stewart, last paragraph on page 167 and top of page 168.)

But supposing it to be decided that a prosecution shall be raised for the removal of the illegal obstruction in the Truim, then comes the farther question, Who is to prosecute—the Spey District Board or the Fishery Board for Scotland? Looking to the terms of 'The Fishery Board '(Scotland) Act, 1882,' it humbly seems to me that the Spey District Board must raise the prosecution, as the 2nd sub-section of the 5th section of that Act provides that 'the Fishery Board shall have the general

'superintendence of the Salmon Fisheries of Scotland, and shall have 'the powers and duties of Commissioners under the Salmon Fishery Acts, '*but without prejudice to or interference with the powers of District* '*Boards.*'

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Answers to Printed Queries from District Boards.—The Tay District Board.

The answers from the Tay District Board are favourable. Both for netting and angling, the year 1891 has been a good one. But were it not for the general goodness of the year throughout the country, they would be inclined to attribute the successful fishing on the Tay to the partial interdiction of the sparling smacks in autumn and spring, which used to capture salmon and smolts under pretence of fishing for sparlings. The heaviest fish caught in the Tay in 1891 by net weighed 62 lbs., and the heaviest caught by rod weighed $47\frac{1}{2}$ lbs. The bye-laws are stated to be fairly well kept, but there were several prosecutions for offences last year, some offenders being fined as much as £10. It is stated that 'the 'present annual close time is as good as it can be under the existing Acts, 'since it has been changed to 26th August and 11th February, but the 'latter is too late for commencement. The rod fishing now begins on 15th 'January, and this will certainly be a great boon to anglers and the pro- 'prietors of upper fishings.'

The artificial obstructions in the Tay District are the cruives and dams on the Earn and Ericht; the natural obstructions are the Falls of Tummel, the Falls of Garry, the Falls of Lochy, the Keith on the Ericht, and Reekie Linn on the Isla. None of these have as yet been made passable for salmon. The salmon disease has again made its appearance in the river, but it is said to be diminishing. There is a Hatchery on the Earn at Dupplin, belonging to the Tay District Board, which, as altered and improved, can hatch out 510,000 ova.

Answers from the Spey District Board.

In tidal and fresh waters the number of fish caught by nets is stated to be much the same as the previous season, but the rod and line fishing throughout the Spey District has been the best experienced for a number of years. The largest fish caught by net and coble and in fixed engines weighed upwards of 40 lbs.; and the largest by rod 35 lbs.

The system of protection in the district is efficient. The men are employed by and are subject to the District Board. The force consists of one Superintendent, one Inspector, and forty-four Constables. There is not much illegal fishing.

There is but one cruive on the Spey, and it was not in use last season. There are some mill-dams on the tributaries, but they are all provided with fish-passes, which afford at all times a free passage to ascending fish. An artificial obstruction has been illegally placed upon the Truim.*

The only pollution in the district is that caused by the refuse from Whisky Distilleries in the shape of 'spent wash' and 'spent lees.' The amount of this liquid allowed to run into the river is increasing; and no steps are taken by the polluters to neutralise the pollution.

The fungoid salmon disease has been known in the district for many years, but only kelts and spawning fish are attacked by it. It is difficult to say whether it is increasing or decreasing. Probably about 12 per cent. of the male kelts are more or less attacked by it. More specific authority to kill and bury the diseased fish should be given to water-bailiffs in any future Act. There is a Hatchery in the district belonging to the Duke of Richmond, which gave satisfactory results last year.

The Superintendent states 'that, from personal observation,' he con-

* For my Report on this obstruction see pages 28–30.

siders that 'there is at least one male to one female fish, and that is 'allowing them to be going both fresh to the spawning bed. Stricter 'observation is to be given to this matter by the bailiffs during the 'present season.' He considers 'that the little black bird with a white 'breast, which is locally known in this district by the name of "Water 'Jock," should be shot down at all seasons, as he is looked upon, and 'with good cause, as an ova eater.' He likewise considers that the interests of the salmon fisheries in the Spey District are greatly injured by the want of a yearly close time for fresh-water trout.

The following is a copy of the Superintendent's Annual Report for the year ending 26th August 1891, submitted to the meeting of the Spey District Board held at Elgin on 23rd October 1891 :—

### *I.—Salmon Spawning.*

The following Tables show the dates of the first appearance of salmon spawning beds, the number seen and counted by the bailiffs during the last two spawning seasons of 1889-90 and 1890-91, on the following named streams or tributaries :—

1889-90.

| Name of Stream. | Spawning Commenced. | Number of Beds for Season. |
|---|---|---|
| Fiddich, | 1st October, 1889 | 545 |
| Avon, | 10th October, 1889 | 484 |
| Livet, | 3rd October, 1889 | 269 |
| Conglass, | 10th October, 1889 | 92 |
| Lochy, | 9th October, 1889 | 49 |
| Dulnain, | 10th October, 1889 | 597 |
| Nethy, | 17th October, 1889 | 175 |
| Druie, | 14th October, 1889 | 166 |
| Feshie, | 16th October, 1889 | 193 |
| Tromie, | 14th October, 1889 | 152 |
| Truim, | 1st October, 1889 | 108 |
| Spey (above Laggan, Badenoch), | 11th October, 1889 | 102 |
| | Total, | 2932 Spawning Beds. |

1890-91.

| Name of Stream. | Spawning Commenced. | Number of Beds for Season. |
|---|---|---|
| Fiddich, | 7th October, 1890 | 535 |
| Avon, | 4th October, 1890 | 607 |
| Livet, | 8th October, 1890 | 132 |
| Conglass, | 4th October, 1890 | 98 |
| Lochy, | 9th October, 1890 | 40 |
| Dulnain, | 11th October, 1890 | 513 |
| Nethy, | 24th October, 1890 | 176 |
| Druie, | 11th October, 1890 | 192 |
| Feshie, | 13th October, 1890 | 265 |
| Tromie, | 14th October, 1890 | 70 |
| Truim, | 10th October, 1890 | 95 |
| Spey (above Laggan, Badenoch), | 9th October, 1890 | 45 |
| | Total, | 2768 Spawning Beds. |
| Decrease in Spawning Beds from last year's number, | | 164 |
| | | 2932 |

Last spawning season, like the preceding, turned out to be rather a poor one, and for the same cause, viz., scarcity of grilse. I have, however, good reasons to believe that, during the coming season of salmon spawning, we shall surmount the grilse dearth of last two spawning seasons, and have one of the best grilse spawning seasons on the high reaches that we have experienced during the early part of the season since 1888–89. My reasons for anticipating this, are, that since the first week of July, owing to the excessive amount of rain which has fallen, causing the river to run high, and often in spate size, grilse have since then been clearing off the sea coast and making their way up the river much earlier and in larger numbers than that seen for many years. The two last spawning seasons come so near each other in the total number of spawning beds counted upon the different tributaries, that I do not think that it is necessary for me to make further comparisons between the two.

From 16th October till middle of December all the tributaries ran high in size, and continued dark or brown coloured, and during all this time, which almost completed the height of the spawning over the higher tributaries, it was seldom that the spawning fish could be seen by the bailiffs, and, by the time the streams returned to their normal size, the fish had spawned and left their 'redds,' which were then to be seen and counted by the bailiffs, notwithstanding that the fish themselves had disappeared again after spawning, and returned down the streams and joined the Spey. When spawning beds are counted in this way by the bailiffs, after a continued period of brown coloured water, the men are very cautious not to give in a list of anything but what they are prepared to swear were proper spawning beds, each of which had been spawned upon by at least one pair of fish, consequently doubtful beds are left out of count, but, all the same, may have been properly formed and spawned upon had a sight of them been attainable when they were being wrought. On the Spey the spawning was not so good as that of the previous year of 1889–90, and owing to the high state of the river, a sight of the fish at work was scarcely to be got from end of October till end of December, by which time the most of the spawning had ceased.

Spawning continued on the Spey till into month of March. From middle till end of December there was a very severe frost, which froze over the pools and spawning fords of Spey, Avon, and Fiddich, but this frost and ice wore away again without causing any injury to the spawning fish or spawning beds. Another severe frost continued during January, and again froze up the pools and spawning fords. Avon on this occasion was most severely frozen up, and upon the breaking up of the ice, after a thaw set in, some thirty spawned fish were found dead in said river, and these had evidently been killed by the ice. There is no doubt but that some damage had been done to the spawning beds upon the Avon by the breaking up of the ice on said occasion.

### *II.—Smolt Season.*

The appearance of smolts while descending the rivers last season was as good as that of former seasons. Eight watchers were on duty for six weeks, commencing 27th April, protecting smolts and parr over the whole district, and the Superintendent, Inspector, and one Constable continued protecting parr during all the summer. Twelve dozen of printed notices, cautioning persons against taking or killing smolts, parr, or the young of salmon, were posted up at conspicuous places along the sides of the river Spey and tributaries, over the whole district.

### *III.—Disease among Fish.*

Fungoid disease was more prevalent during last winter or late spawning season than that of the season of 1889–90. On the Fiddich, during the season 1889–90, the number of spawning beds counted was 545, and the number of dead diseased fish removed from the same stream was 64. During last season (1890–91) the number of spawning beds was 535, or 10 fewer than the previous year, and the number of dead diseased fish that were removed and buried was 92. The percentage for dead diseased fish on the respective numbers of beds upon the Fiddich during the two spawning seasons previous to the last one

of 1890–91 was the same, viz., 13 per cent., but the percentage for last season of 1890–91 has gone up as high as 18 per cent.

### *IV.—Poaching during the Year.*

During the whole of last close time there was not a single detection made against any poaching or attempt to poach over the whole district. As I have already mentioned in this report, during the height of the spawning all the rivers and streams ran high and dark coloured, and made poaching almost impossible during the time that attempts to do so would have been most likely made.

The only offender brought up for trial during the year was a pensioner, residing in Rothes, who was detected fishing on Spey, near Rothes, on 1st June last, with one smolt and one parr in his possession. Accused was brought before the Sheriff Court at Banff on 26th June, where he pleaded guilty to having killed the smolt and parr, and was sentenced to pay a fine of 5s., with 10s. 6d. of modified expenses, failing payment, twenty-four hours' imprisonment.

### *V.—Bye-laws.*

The bye-laws relating to mill-dam dykes, mill-lades, sluices, hecks, &c., were all properly attended to during the year over the whole district.

### *General Remarks.*

The sea coast and river salmon net opened on 11th February and closed on 26th August, with the exception of some six or eight nets on the sea coast between Portgordon and Findochty, that the fishermen, in consequence of an unusually strong flow tide and strong wind, were unable to get brought ashore until early on the morning of 27th August. So strong was the tide running at this part of the coast on the 26th August that some of the above-mentioned nets were wrecked. The observance of the weekly close time over the whole district of salmon-net fishings was duly observed and carried out on every occasion when practicable.

In consequence of there being some two or three hundred navvies employed at the works of the Aviemore and Inverness new line of railway at Carrbridge, it will be necessary to have at least two additional bailiffs put on duty on the Dulnain at Carrbridge to assist the usual local bailiffs to protect the fish during the coming close time. Carrbridge is the centre of the best spawning grounds upon the Dulnain, and all sorts of characters are likely to be found among so many navvies.

As has been already fully reported, Colonel Lachlan Macpherson of Glentruim, during the first of last summer, caused to be erected upon the Truim stream a dyke which will at least cause a partial barrier to ascending fish on said stream or river.

The full force of bailiffs or Spey police is constituted as follows :—The Superintendent, stationed at Aberlour ; the Inspector, stationed at Granton ; eight Sergeants, and thirty-four Constables.

GEO. K. MACGREGOR, *Superintendent.*

## Abstract of Account Charge and Discharge of Clerks' Intromissions, Year 1890–91.

### I.—CHARGE.

| | £ | s. | d. |
|---|---|---|---|
| To Fishery Assessment on £9669, 5s. of Rental, at 1s. 11d. per £1, | £926 | 12 | 10 |
| „ Fines and Expenses recovered, | 0 | 15 | 6 |
| „ Advance for Men's Wages to 4th October 1890, from last year's Account, | 56 | 8 | 8 |
| „ Amount at Credit of Board with Royal Bank as per last Account, | 26 | 9 | 5 |
| | £1010 | 6 | 5 |

## II.—DISCHARGE.

| | | | |
|---|---|---|---|
| By Wages to Inspector and Bailiffs for year, . . . . . | £719 | 18 | 11 |
| „ Superintendent, £130, and his Travelling Expenses, £32, 11s. 1d., . . . . . . . . . . | 162 | 11 | 1 |
| „ Bank Interest, Extracts from Valuation Rolls, Printing, and Bank Charges, . . . . . . . . . . . | 24 | 11 | 9 |
| „ Clerk's Salary and Outlays, . . . . . . . . | 26 | 16 | 2 |
| „ Legal Expenses, . . . . . . . . . . . | 7 | 17 | 1 |
| „ Advances for Men's Wages to be charged against next year's Assessment, . . . . . . . . . . | 50 | 11 | 8 |
| „ Arrear of Assessment, . . . . . . . . . | 1 | 18 | 4 |
| „ Balance at Credit of Account with Royal Bank, Elgin, . . | 16 | 1 | 5 |
| | £1010 | 6 | 5 |

Answers from the Forth District Board.

There has been a general increase in the take of fish in the Forth District during 1891. The fishing was very good in the lower reaches and 'exceedingly good' in fixed engines. The heaviest salmon was caught by a hang-net at Alloa, and weighed 48½ lbs. The heaviest caught by rod was at Craigforth, and weighed 44 lbs. There are twelve watchers employed by the District Board, and the protection of the river is efficient. There are no dam-dikes which offer serious obstruction to the passage of salmon. The pollution of the Devon, a tributary of the Forth, is as bad as ever, and no steps are taken by the polluters to abate or neutralise the pollution.

Answers from the South Esk District Board.

There was a general increase in the Fisheries in the South Esk in 1891, which is imputed to the better protection of the river during the spawning season. It is difficult, if not impossible, to give an accurate account of the number of fish caught, but the estimate given is 4000 by net and coble; 38,000 in fixed engines; and 900 by rods. The rod fishing has been he best known for many years. The heaviest salmon caught by net and coble weighed 25 lbs.; by fixed engines 42 lbs.; and by rods 28 lbs. A Superintendent and six water-bailiffs are employed. There were twelve prosecutions in 1891, followed by convictions in almost every case.

There are no cruives on the river, but there are dams at Kinnaird, East Mill, Brechin Castle, Blackie Mill, Finavon, and Murthill. They are worked in accordance with the bye-laws, and afford a passage to fish.* There are no natural obstructions in the river. Formerly the South Esk was much polluted, but since an action was raised by the river proprietors, some years ago, matters have considerably improved, and at present there is not much cause of complaint.

The salmon disease made its first appearance in September last, and has since gone on increasing. At present (November 30th), the majority of the fish are more or less diseased. The cause and the remedy of the disease are mysterious, but there can be no doubt that more specific powers should be given to water-bailiffs to take out and destroy diseased fish.

From appearance of fish going over dikes, male and female fish would seem to be in about equal numbers. The Wild Birds Protection Act as regards gulls and other birds known to destroy smolts and ova should be repealed.

Answers from the Aberdeenshire Dee.

There has been a general increase in the take of fish in the Dee at most of the fishing stations by fixed engines and net and coble, and by rod on the river, attributable to favourable state of wind and weather at commencement, and well on during the earlier part of the season; also, that the

* The fish-way on the dam at Brechin Castle, which has always been the worst obstruction on the river, though somewhat improved does not yet afford a free passage to ascending fish.

nets on the middle and upper reaches of the river having been taken off by the proprietors with a view to increasing the rod fishing, the fish get more freely up to the spawning beds. The weight of the heaviest salmon taken by fixed engines was 56 lbs., and by rod 47 lbs. It is stated that the annual and weekly close times have been strictly observed; but, with regard to the annual close time, it is suggested by a good many persons that the fishing in this district should commence about a fortnight earlier—say on the 28th January instead of the 11th February. The system of protection is efficient. The river watchers are not connected with the County Constabulary Force, but are employed by, and subject to the District Board. They are twenty-three in number, including four men in the steam-launch, which is the joint property of the Dee and Don Boards.

Illegal fishing has almost ceased at the mouth of the river and on the coast since the Dee and Don District Boards provided a steam-launch for further protection. On the river, as compared with former years, illegal fishing has not been so prevalent. The number of prosecutions in 1891 was five. There are no obstructions by dams or cruives, but there are waterfalls on the Feugh and Lui, and the proprietors are being communicated with in order to their being opened up, which could be done by slight cutting and ladders. The spawning grounds above are good and extensive. As regards pollutions, the sewage of Braemar, Balmoral, Ballater, Aboyne, Kincardine O'Neil, and Banchory is discharged into the river. This has necessarily been increasing, but in certain of these places (Ballater, &c.), some movement is being made towards providing a remedy. The salmon disease showed itself on 1st November last; both kelts and clean fish were affected, but it is now extinct. There are two Hatcheries for the propagation of salmon only; one in the Aberdeen Salmon Company's premises at Aberdeen, belonging to the Dee and Don Boards jointly, and another at Durris, near the river, rented by the Dee Board. The former hatches out from 12,000 to 20,000 fry yearly, and the latter from 500,000 to 600,000.

The proportion of male to female salmon is estimated at two males to one female.

**Answers from the Don District Board.**

There has been a general slight increase on the sea fishings, made up principally at the end of the season, when the wind changed to a more favourable direction and the tides were suitable. The river fishings slightly decreased, owing to the smallness of the body of water and favourable conditions of the weather for the working of the sea fishings. The weight of the heaviest salmon caught by fixed nets was 52 lbs., and by rod 50 lbs. The annual and weekly close times have been strictly observed, but it is suggested, as regards the annual close time, that the time for the commencement of the fishing should be put back say ten days, viz., from 11th February, as at present, to 21st February, and the closing day extended to say 6th or 8th September, and the rod fishing should cease on 20th in place of 31st October. The reason for this latter suggestion is that it would prevent anglers fishing at a time when the fish are full of spawn, and on the spawning beds. There are twenty river watchers on the Don. The steam-launch kept at the joint expense of the Dee and Don Boards has proved most efficacious in keeping down illegal fishing. There were ten prosecutions in 1891; all the offences were committed on the river. There are no natural obstructions on the Don, but the artificial ones are numerous and serious, consisting of the Cruives and the dams at Kettocks Mills, Grandholm, Persley, Mugiemoss, and Stoneywood. It is stated that they are all worked in accordance with the provisions of the bye-laws, and that there are fish-passes that

afford a free passage at all times when there is sufficient water in the river. But such is the enormous quantity of water drawn off by the huge lades attached to these dams, that when the river is small it is nearly all carried off into the lade. Nothing comes over the dams, and the bed of the river between the intake and tail-lades is left nearly dry. This I have again and again observed on the Don. The bleaching and other deleterious matters discharged from the mills at Mugiemoss, Stoneywood, Port Elphinstone, and Gordon Mills, do a considerable amount of harm, especially when the river is low. The salmon disease appeared slightly in November last; but it is now extinct. Proportion of male to female salmon is estimated at two males to one female.

Answers from the Ythan District Board.

The Ythan is a very productive little river. The take of fish showed a general increase in 1891, both in tidal and fresh waters. About 3454 sea-trout and 6528 salmon were taken in nets, and about 300 fish by rods. The heaviest salmon taken in fixed nets weighed 37 lbs., and the heaviest sea-trout 10 lbs.; and a salmon of 30¼ lbs. was taken by the rod. The bye-laws are said to be fairly well kept—except that relating to the observance of the weekly close time by bag-nets. The Board are of opinion that the annual close season on the Ythan should be from 20th September to 6th March. There is not much illegal fishing in the district. There is one watcher all the year round, and four or five additional watchers from September to March. There are no dams on the Ythan, and no natural obstructions. It is somewhat contaminated by the sewage of the village of Ellon, which is increasing. The salmon disease has made its appearance, and has attacked both kelts and clean fish, but it seems to be diminishing. It is estimated that there are six male to four female salmon. The head water-bailiff suggests that the Wild Birds Protection Act should be repealed as regards Scotland.

Answers from the Ugie District Board.

The Ugie is another very productive little river which falls into the sea near Peterhead about 15 miles north of the Ythan. The take of fish has been about an average one, but somewhat larger in fresh waters. It is estimated at 1500 sea-trout and 4300 salmon and grilse in nets; and 115 salmon and grilse and 254 sea-trout by rods. The heaviest salmon was 60½ lbs., and the heaviest sea-trout 23 lbs. caught by nets, and the heaviest rod-caught fish were a salmon of 27½ lbs. and a sea-trout of 14 lbs. The close times are satisfactorily observed, but it is generally thought that the annual close time should commence a fortnight later than at present. Illegal fishing is not prevalent, and the protection is efficient.

The only cruives in the district are those at Inverugie, and they have been disused for a number of years. There are various dams, and the condition of them has been for some time and is still engaging the attention of the Board. One of them (Ravenscraig), was in process of being reconstructed, but the work was seriously damaged by a flood. It is expected that it will be recommenced next spring.

As to pollution, minor sources of pollution enter the river, but it is not believed that they do so to an exceptional extent. The pollution formerly referred to as proceeding from a manufactory has been considerably abated, at least for a time, owing, as it is understood, to certain means having been taken for neutralising the substances flowing from it into the river. A more serious case of pollution arose from a public dung depot situated near the mouth of and at a little distance from the Ugie, in respect of which a prosecution took place, resulting in a conviction by the Sheriff, but the sentence was suspended by the Court of Justiciary owing to a blunder in recording the proceedings in the Sheriff Court made by an official.

The Ugie was free from the salmon disease during 1891.

There is a small Hatchery on the Ugie at Inverugie, supported by private enterprise, which, after being disused for some years, is again in operation. About 60,000 fish can be hatched out in it annually. The proportion of male to female salmon is estimated to be five males to four females.

The season of 1891 is stated to have been an average one on the Deveron. A salmon of 37 lbs. was caught by net and coble, one of 48 lbs. by fixed engines, and one of 33 lbs. by rod. The system of protection is efficient, and there are eleven water-bailiffs employed. There is one cruive, belonging to the Duke of Fife, which is worked in accordance with the terms of the bye-law. The salmon disease showed itself in 1891, but to no great extent. There is a Hatchery belonging to the Duke of Fife which is capable of hatching out 200,000 salmon. Answers from the Deveron District Board.

A proprietor of salmon fishings on the Deveron writes me that up to 1891 the fishings had been diminishing, but that in 1891 'the take has been phenomenal—more than double the best here hitherto. 'The heavy rains in September drew the fish to the river, and the rain 'continued until about the end of October, when, the river getting very 'low, they could not run. The sea-nets, by all accounts, did wonderfully, 'so that it has been a great fishing year, not only over all our river, but 'on all rivers I have heard of.'

About the salmon disease he writes:—'Towards end of October disease 'began to show itself to some extent; but I believe there is some, to 'more or less extent, every season. No idea of cause, unless the accumulation of heavy female fish below the cruive dike, hundreds of which have 'to be lifted over the dike to spawn.' He is of opinion that stake and bag-nets are allowed too close to the mouth of the river (400 yards). The distance should be double. He also thinks that there should be a slap in all cruive dikes, and that the cruive boxes in cruive dikes should be on the bed of the river, and not, as now, feet above it—caused by silting-up of the bed and addition to height of dike under name of repairs. 'The 'best plan,' he concludes, 'would be the removal of all cruive dikes (with 'fair compensation), as being only useful and profitable to one man; those 'above and below alike suffering from them.'

The take of fish fell off in the estuary of the Findhorn and in the river during 1891; but not throughout the district, and especially not in the long range of fixed nets with outriggers in Bessy Bay. The estuary is stated to be too narrow. It was fixed by the Commissioners of Scotch Salmon Fisheries by a bye-law which took effect from 7th March 1865, and was, I humbly venture to think, illegally and incompetently fixed. By the 16th section of 'The Salmon Fisheries '(Scotland) Act, 1862,' the Commissioners were empowered 'to fix and 'define, for the purposes of this Act, and the other Acts relating to 'Salmon and Salmon Fisheries in Scotland, the natural limits which 'divide each river in Scotland (including the estuary thereof) from the 'sea, *in so far as the same may not be already fixed by statute or by 'judicial decision*.' But, in consequence of certain proceedings which took place before the Barons of Exchequer in Scotland in 1776–8, the limits of the estuary of the River Findhorn *were judicially fixed and defined* by them as extending a great distance on either side beyond the estuary subsequently fixed by the Scotch Commissioners, which was, therefore, fixed in defiance of the terms of the statute, and in the face of a judicial decision previously existing. A map of the Findhorn, showing the two estuaries, and a Memorial from the proprietors of river fishings against the Commissioners' bye-law form Appendix IX. to my First Report to the Board on the 'Salmon Rivers on the East Coast, from the 'Forth to the Kyle of Sutherland, both inclusive.' Answers from the River Findhorn.

Fish of 40 lbs. weight were killed on the Findhorn in 1891, both by net and coble and by fixed nets; 22½ lbs. was the heaviest fish killed by the rod.

The present annual close time on the Findhorn is from August 27th to February 10th, and the extension of time for rod fishing is from August 27th to October 10th; the rod fishers in the district think that the extension of time for rod fishing should be from August 27th to October 31st; and, looking to all the circumstances of the case, I should be glad to see such an alteration made.

The Nairn.

The fishing in the Nairn District is said to have slightly increased in 1891, owing, it is thought, to a few good spawning seasons. The heaviest salmon taken in fixed nets was 30 lbs., and the heaviest caught by rod was 20 lbs. There are no cruives on the river, and the few dams that there are offer no obstruction to ascending fish. There is ample and excellent spawning ground. The annual close time applicable to the Nairn was altered last year by Order under the Secretary of State's hand; and the extension of time for rod fishing is now from August 27th to October 31st, instead of from August 27th to October 15th.

Kyle of Sutherland.

In this district, which includes the Shin, Oykell, Carron, and Cassley, the fishing increased greatly and generally during 1891, owing to there being no poaching at the mouths of the rivers; 13,000 fish were taken by net and coble; 5000 by fixed engines; and 1100 by rod and line. The heaviest salmon caught by net and coble was 33 lbs.; the heaviest in fixed nets 38 lbs.; and the heaviest by rod 34 lbs. The close times are strictly observed, and the system of protection is efficient. There are eight watchers. Glenmuick Falls prevent salmon from getting up the river. There is good spawning ground above them; and they are in the course of being opened up by dynamite. There are neither pollutions nor salmon disease in the district.

Helmsdale, Brora, and Fleet, Sutherlandshire.

1891 was an excellent season in the Brora, Helmsdale and Fleet, attributable mainly, if not altogether, to good fishing weather prevailing throughout the season, with abundance of fresh water. The largest increase was in grilse. 1689 salmon weighing 18,220 lbs.; 4310 grilse weighing 23,272 lbs.; and 300 trout weighing 509 lbs., were taken by net and coble; and about 2000 fish were taken by the rod. A salmon of 40 lbs. was taken by net in the Brora, and one of 33 lbs. was captured by the rod in the Helmsdale. The system of protection is efficient, and there is very little illegal fishing. There is a Hatchery in the district, near Loch Brora, belonging to the Duke of Sutherland. It is capable of hatching out from 150,000 to 200,000 salmon. About 80,000 salmon were hatched in the spring of 1891, and distributed over the district; 11,000 Loch Leven trout were likewise hatched out.

Hope, Naver, Borgie, Dionard, &c., Sutherlandshire.

There is stated to be very little change in the productiveness of these rivers. About 11,500 fish were captured by nets. The heaviest salmon caught by net and coble was 24 lbs., the heaviest by fixed nets 35 lbs., and a fish of 35 lbs. was taken by the rod in the Naver.

Rivers on west coast of Sutherland—Kirkaig, Inver, Laxford, &c.

The fishing in these rivers and districts was better in 1891 than in 1890, owing to the quantity of rain affording easier access to the rivers. 1114 salmon, 8829 grilse, and 351 sea-trout were captured by fixed engines; and 580 salmon and grilse were taken by the rod. The rivers here are late, and it is rare to catch fresh-run salmon by the rod in any of them until the end of May. Salmon over 25 lbs. are seldom caught. The average weight for salmon is about 12 lbs., and for grilse 6 lbs. The protection is efficient, and illegal fishing is almost unknown. There are no cruives or dams to obstruct the run of fish, but there are two impassable waterfalls on the Kirkaig. There are two Hatcheries in the

district—one in Assynt, the other in Eddrachillis. 50,000 can be hatched in each. A quantity of ova from the Duke of Sutherland's Hatchery at Brora has been imported into the district. In obtaining ova from the rivers, the proportion of male fish far exceeded that of female—five to one.

Answers from the Lochy and Spean.

In the Lochy and Spean the fishing was nearly a half better in 1891 than in the previous year. There are no nets on the rivers; all the fishing is by rod. The angling is the best on the West Coast of Scotland. It is suggested that a small steam-launch would aid much in enforcing the observance of the bye-laws. The police, coastguard, and preventive men should also be called on to assist. There are twenty-two watchers on the Lochy and Spean, and the protection is as efficient as is compatible with a reasonable outlay; but there is a good deal of poaching on the sea coast. There are no artificial obstructions, but there is a natural obstruction on the Spean at the Falls of Mounessie which could be blasted without much difficulty, and another further up at Inverlair, which would be more costly to make passable for salmon. These obstructions shut out salmon from about 40 miles of river, and several lochs. The salmon disease showed itself in 1887 both in kelts and clean fish; but there has been no noticeable increase. It is suggested that fishermen, dealers or others, having salmon or fish of the salmon kind in their possession, should be obliged to give an account to watchers or other persons in authority of how the fish came into their possession, and that dealers and shopkeepers should be obliged to keep a book, like game-dealers, in which their purchases are entered, and from whom. This to apply to all seasons of the year, and the legal presumption to be against the possessor of the salmon or fish of the salmon kind. It is further suggested that no fish of the salmon kind should be sold in any district after the nets are off.

Chairman of the Annan District Board.

Mr A. Johnstone Douglas, the Chairman of the Annan District Board, expresses his views, as follows, with regard to the vexed and thorny Solway Question, which has been considered by so many Special Commissions since Mr Buckland and I reported on it in 1871, but which has never as yet been attempted to be solved by Legislation, without which there can be no adequate or satisfactory solution :—'Nothing short of Legislation,' writes Mr Douglas, 'for regulating the whole of the fishings on the 'English and Scotch shores of the Solway, can possibly unravel the 'tangled skene of laws at present applicable to the Solway Firth. The 'right of salmon and the public right of white-fishing has, for many years, 'been in serious conflict on the Scotch side of the Solway, and the 'Legislature should step in and define the rights of the conflicting 'interests. The paiddle-net fishers at Pow-foot are a respectable in- 'dustrious class of men who have had their legitimate and lawful trade 'well-nigh confiscated and abolished by the action of one of the largest of 'the stake-net lessees. Water-bailiffs or the police should be armed at all 'times with the necessary powers of search for fish suspected of being 'illegally caught, and the law at present regulating the traffic in game 'should be made applicable to fish.'

Mr Douglas states that 'the annual close-time is not observed by the 'whammel-net fishers who fish outwith the jurisdiction of the Annan 'District Board beyond low-water-mark. The 9th section of the Solway 'Act, 1804, is inoperative, inasmuch as it does not apply to the sea; 'and, consequently, the only process available by the proprietors of 'Salmon Fishings to protect their right is by way of civil interdict, a 'costly and expensive method of proceeding. The annual weekly close- 'times differ on the English and Scotch shores of the Solway. They 'should be made the same; and any fisherman, holding a license from the

'Eden Fishery Board, should be ineligible for a renewal of his license for 'a period of 12 months, should he be convicted of poaching during the 'annual or weekly close-times.'

Mr J. Bell Irving of Mount Annan.

Mr Irving states that about 600 fish were captured in the Annan in 1891, the chief capture being after the nets are off, as scarcely any fish can get into the river before that. The heaviest salmon caught by the rod weighed about 44 lbs. Protection, he writes, is 'very inefficient; 'the upper waters are wholly unprotected. About half-a-dozen members 'of county constabulary force for sea and river. Illegal fishing is rampant 'in the Solway. Prosecutions were instituted for all sorts of offences. 'Fines imposed absurdly small, and no check on poaching. In the Newbie 'weir there are half-a-dozen iron stakes in the fish-pass which get 'choked with rubbish and block the pass when the water is low. There 'is no guard to the Mill-lade at either end. Though the local Fishery 'Board have frequently had their attention drawn to these matters, 'nothing whatever has been done. The whole Legislation, as regards the 'Solway and the rivers flowing into it, should be gone into and changed. 'At present, the laws on the Scottish and English sides are quite different, 'and so are the weekly close-times. Most damage is done by whammel-'nets (hang-nets) licensed by the Eden Fishery Board. They are up to '800 yards of net. There are over 40 boats, and they fish everywhere 'and at any time.'

Mr John W. Dickson, Nith District Board.

Mr John W. Dickson, a member of the Nith District Board, writes as follows:—'I think the over-netting in the Estuary, and the pollutions of 'Dumfries, are the principal causes of the deterioration of the fishing in 'the Nith, and the Weir at Dumfries, where the salmon-ladder, in 'summer, is generally inoperative, owing to want of water. I am told 'that large numbers of fish are gathered by people who go out regularly 'to look for them after the turn of the tide, which are supposed to be 'poisoned by the effluents from the mills. They are got in a dead or 'dying state, when the river is low, in dry seasons.'

Nith District.

I have received very full answers to the printed queries from a gentleman who has been thoroughly acquainted with the fisheries in the Nith District for more than 20 years. He states that in 1890 there were no fewer than 41 whammel-nets, whereas, in 1880, there were only 14; also that there are 4 whammel-nets in the tidal portions of the Estuary of the Nith, whereas, a few years ago, there was but 1. There are no salmon stake-nets in the Nith District, only paiddle-nets which numbered 112, and were removed by the Court of Session in 1886 as nets nominally set up for the capture of white fish, but really calculated and used for taking salmon. These nets are now being gradually re-erected though not in the same numbers.

There are several natural obstructions to the passage of salmon on the Nith and its tributaries; at the rocks at Gribton Saw-mills on the Cluden or Cairn; two water-falls on the Scaur; and at Airds Linn near the junction of the Shinnel and Scaur. There are some splendid stretches of spawning ground above these which could be opened up by blasting the rocks. Indeed, there are few rivers that could be compared to the Nith for excellent spawning beds, provided a sufficient number of salmon could get access to them during the open and close season. But unless some restriction is placed on the whammel-nets the fishings will soon be completely ruined. Several artificial obstructions in the shape of dams, likewise impede the passage of salmon in the Nith District. When I inspected it in 1883, there were no fewer than 22 dams, of which 8 on the tributaries varied from 7 to 18 feet in height, and of course formed absolute obstructions to the ascent of salmon. There were no

hecks on the lades in connection with 17 of these dams, and no fish-passes.*

At Dumfries, the drainage of the town is allowed to flow into the Nith as well as the poisonous chemicals and dye stuffs from 4 large tweed mills and 1 dye work. The pollution is increasing and no steps are taken to counteract it. The effect of the pollution, especially during summer when the river is low, is to turn the fish back with the ebb tide to the channels of the Solway where they fall a prey to the whammel and haaf nets. A special Act should be passed for the Solway Firth so as to regulate the weekly and annual close season which ought to be the same on the English and Scotch sides of the Firth. At present, the English weekly close time is from 6 a.m. Saturday till 12 o'clock midnight on Sunday—42 hours; the Scotch weekly close time being from 6 p.m. on Saturday till 6 a.m. on Monday—36 hours. Then the annual close time on the English side under the Eden Board of Conservators, is from the 10th September till 10th February; whereas, on the Scotch side, it is from 10th September till 25th February. There is much poaching done by the formidable whammel-nets in consequence of this difference in the close seasons.

A clause like the 2nd clause of the Poaching Prevention Act of 7th August 1862, should be made to apply to salmon; and dealers or others having salmon, or fish of the salmon kind in their possession, should be obliged to give an account to watchers and others in authority of how the fish came into their possession, and should be obliged to keep a book, like game dealers, in which their purchases of salmon should be regularly entered. No salmon should be allowed to be sold during the extension of time for rod fishing.

The Border Esk.

This river is leased and protected by the Esk and Liddel Angling Association, who issue angling tickets for the year, month, or shorter period. The Secretary states that, in 1891, sea-trout and herling were about an average, and salmon much above the average. This increase is accounted for by the river happening to be in flood when the salmon were leaving the sea. The heaviest salmon caught was 37 lbs.; the heaviest sea-trout 5 lbs.; and the heaviest herling $1\frac{1}{4}$ lbs. Four water-bailiffs are employed. There are no obstructive dams on the river; fish can easily ascend. The salmon disease showed itself in the middle of October, and attacked kelts, clean fish, and burn trout. It is increasing. It is suggested that it would be desirable to continue the fishing season until the middle of November.

Answers to Printed Queries concerning Loch Lomond and tributary streams by Mr Alfred Brown.

Mr Alfred Brown, author of the '*Mollusca of the Clyde*,' who for years has been intimately acquainted with Loch Lomond, writes me fully about it during the season of 1891. 'The season of 1891'—he says—'was one of 'the worst ever known. No rain fell from March till middle of July, during 'which time Loch Lomond and the Leven were at lowest known levels. 'About middle of July a spate took place, causing a good run of fish, and 'the tacksman on the Leven and Clyde had a fortnight's good fishing with 'net and coble; the water then fell back to its old level, and when it 'again began to fill, about the middle of August, *no run of fish took place*, 'and, though the level continued to rise all through autumn, very few 'fresh fish were seen. From 10th or 15th August till 20th September 'the rise in Loch Lomond was nearly 5 feet (perpendicular), yet it did 'not bring the fish.'

When I inspected Loch Lomond and its tributary streams in 1890, I strongly recommended that an almost impassable dam on the River Luss, about five minutes walk from Luss Hotel, should be made accessible for

* For a full account of the waterfalls and dams on the Nith and its tributaries, see my Second Report to the Board, pages 100–101.

salmon. There are many miles of excellent spawning ground above, and it would not cost above £20 to make the dam passable, in the way I pointed out. I find, however, that nothing has been done, and it remains as great an obstruction as ever. The salmon disease showed itself for the first time in Loch Lomond in 1891, but to a very slight extent. The pollution of the Leven is still very bad, but there is said to be a hope of a new sewage system for the townships on its banks and a joint agreement as to filtration by the owners of the dye works.

Forth District—Answers from Mr Harvie-Brown.

That accomplished naturalist, Mr Harvie-Brown, in writing about the fishing season of 1891, expresses himself as follows :—'I cannot account 'for the phenomenal run of salmon and sea-trout all over Scottish rivers in 'autumn of 1891, as related to me at all hands, but I believe it has to do 'with a wider and recurring migration—different in scale and circum- 'stances to the annual ones, also to the conditions of spawning 'grounds of past few years. But I have no data.' He gives a harrowing account of the pollution and obstructions of the Carron and the Bonny, tributaries of the Forth.* He strongly objects to many things in the present system of salmon management. 'Preservation of kelts: and of 'old and large fish: killing down our best breeders and spring and summer 'fish: closing rivers when they ought to be open: opening the early 'fishing when it ought to be closed, to enable fish to reach their *best* 'spawning ground: allowing old fish and heavy fish to spawn in the 'lower reaches, and prey upon their cousins, or nieces, or nephews on their 'way to the sea: protecting the *Bull-trout* (*eriox*), which run late and 'stock Tweed and other rivers to the partial exclusion of salmon: 'making "burning the water" a far greater offence in the eye of the law 'than manufacturers' pollutions, whereas, if fish are speared *and taken out* '*after*, it is a relief to the surcharged pool: where a small family can 'live in comfort, a family ten times bigger than the house can give suffi- 'cient cubic air measurement to could not. Same with fish and water.'

River Lossie—Answers from Captain Dunbar Brander.

In my Eighth Report I had the honour of pointing out to the Board the peculiar and unfortunate position of Captain Dunbar Brander of Pitgaveny, who is proprietor of salmon fishings in the sea in the district of the Lossie, and also lessee of all the salmon fishings in the river, but who yet, as the law at present stands, cannot prosecute for the contravention of a bye-law in the district, it having been decided that all such prosecutions must be brought, in the first place, at the instance of the Clerk to a District Board, and there is no District Board for the Lossie. None of the dams on the Lossie have fish-passes, and there is not a single mill-lade with hecks. Captain Dunbar wrote me as follows on the subject in November last:—'The Salmon Acts, so far as the River Lossie is con- 'cerned, are a complete failure. There is no District Board. The three 'proprietors entitled to form a Board won't agree—the Duke of Richmond, 'the Earl of Moray, and myself. I wish to have a Board, but the other 'two won't join; there is not a grating on a single mill-lade on the river. 'I tried to enforce the law, and had a miller up before the Sheriff. The 'Sheriff said it was only the "Clerk to the Board" that could order a 'grating, *not every common informer*—which I was in point of law. 'There being no Clerk, there is no one entitled to enforce the bye-laws. 'This should be remedied in any future legislation.'

The remedy for the hardship of which Captain Dunbar complains, as I have pointed out in a former Report, is simple, but it requires further legislation. It is to add the words in italics to the 37th section of the Salmon Fisheries Act of 1868 :—'Any proprietor of a fishery shall be held 'to have a good title and interest at law to sue by action any other pro- 'prietor or occupier of a fishery within the district, or any other person

* Yet less than 100 years ago, the Carron was one of the best trout rivers in Scotland. See Note V., page 57.

'who shall use any illegal engine or illegal mode of fishing for catching 'salmon within the district, *or who shall contravene or fail to observe any 'bye-law.'*

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I have received between thirty and forty answers to the printed queries from hotelkeepers having salmon and trout, or both kinds of fishings, attached to their hotels. One noticeable feature of these answers is that nearly all the hotelkeepers are in favour of an annual close time for trout, though they are not agreed as to the time over which it should extend. Several are in favour of both a gauge and a close time. The gauge recommended varies from 6 to 9 inches. In a good many cases a gauge is already enforced, and no trout under a certain size is allowed to be basketed. Several answers are from the happy fishing grounds of Sutherland. At the head of these may be placed those from Altnakealgach Hotel on Loch Borrolan. In 1890, 22,000 trout weighing 7151 lbs. were captured by the gentlemen fishing from this hotel—the heaviest trout weighing 9½ lbs.; and, in 1891, 15,600 were caught weighing 4921 lbs.—heaviest trout 8 lbs. Or, in the two years, 37,600 trout weighing 12,072 lbs. There are four fine sheets of water within easy reach of Altnakealgach Hotel—Loch Borrolan, Loch Urigill, Cama Loch, and Loch Veattie. None but yellow trout can reach any of these, as the Falls on the Kirkaig are quite impassable. The hotelkeeper states that the trout are decreasing, owing to the lochs being overfished. I think this is highly probable, as there is no Hatchery in the district, and nothing is done by artificial stocking to supply and compensate the great destruction of trout. The best months for these lochs are June, July, and August.

Answers from hotelkeepers having fishings attached to their hotels.

Altnakealgach Hotel.

From Forsinard hotel, near the upper part of the Halladale River, 23 salmon, weighing 177 lbs., were caught in 1891, 7 sea-trout, weighing 18 lbs., and 2730 yellow trout, weighing 1092 lbs.; the heaviest salmon was 18 lbs., heaviest sea-trout 3 lbs., and heaviest yellow trout 7 lbs. May, June, July, and August are the best months. The lochs in the neighbourhood have been stocked with Loch Leven fry from the Brora Hatchery. An annual close time for trout is suggested from 1st October to 1st March, and a gauge of 7 inches.

Forsinard Hotel, Sutherlandshire.

The salmon in the River Shin are stated to have been more plentiful in 1891, owing to the river having been in good condition, and net-fishing having been abolished at the mouth. Yellow trout have diminished for the last few years, owing to the overfishing of the lochs. From 1st July to 10th August, 52 salmon were caught; and from beginning of June to end of September, 2000 yellow trout, averaging half-a-pound each. The heaviest salmon was 20 lbs., and the heaviest trout 3½ lbs. July and August are the best months for salmon and grilse; and June, July, and August for yellow trout.

Sutherland Arms Hotel.

It is stated that the salmon, sea-trout, &c., in the waters near this hotel, have been increasing for some years. 150 salmon and grilse were killed in 1891. Heaviest salmon was 22 lbs., and sea-trout 2½ lbs. The yellow trout average 4 to the pound.

Oykell Bridge Hotel.

There is not much yellow trout fishing attached to Durness hotel. In Loch Craspuil, half-a-mile from the hotel, there are beautiful silvery trout like land-locked sea-trout. They are very shy, and tender in the mouth. The best basket made in 1891 was 12 trout, weighing 10 lbs.—heaviest trout 2½ lbs. By far the best fishing at Durness is trolling for sea-trout in the salt water of the Kyle of Durness. The best basket made in this way in 1891 was 35 sea-trout, weighing 67 lbs.

Durness Hotel.

Answers from Dalmally and Loch Awe Hotels.

I have several answers from Loch Awe, on which there are now so many popular and picturesque anglers' resorts. From Dalmally and Loch Awe Hotels, it is stated that the trout fishing in the loch has diminished, owing to drought; and, on the Orchy, salmon fishing has fallen off, owing to the nets at the mouth of the Awe. 36 salmon, weighing 482½ lbs., were taken in the Orchy from Dalmally Hotel, and 500 trout in Loch Awe, averaging ½ lb. each. From the Loch Awe Hotel 5 salmon weighing 50 lbs. were captured, and 611 yellow trout averaging half-a-pound. One yellow trout was 5 lbs. Altogether, Mr Fraser states that 1891 was the worst season he has had.

Port Sonachan Hotel.

From Port Sonachan Hotel there is likewise a somewhat unsatisfactory account. The heaviest salmon was 16½ lbs.; the heaviest sea-trout 3 lbs.; the heaviest *salmo ferox* 12 lbs.; and heaviest yellow trout 5 lbs.

Taycreggan Hotel.

From Taycreggan Hotel it is stated that the yellow trout fishing has fallen off; but that the salmon fishing has improved. The heaviest salmon was 15 lbs., the heaviest brown trout 1¾ lbs., and heaviest sea-trout ¾ lbs. The decrease in the trout fishing is attributed to overfishing. March, April, May, and June, are said to be the best fishing months.

Answers from Dr M'Nicoll of Dalmally.

Dr M'Nicoll, Dalmally, Secretary of the Awe Fishery Protection Association, gives a by no means rosy account of the fishings in Loch Awe. He states that for several seasons there has been a very marked decrease in the angling; this he imputes to the constant fishing with nets in the mouth of the Awe from dawn to dark during six days in the week. He mentions the obstructions on the Avich, which runs out of Loch Avich into Loch Awe, as shutting out a large extent of valuable spawning ground. These obstructions, and the best means of overcoming them, will be found fully described in my Sixth Annual Report to the Board, pages 54 and 55.

Taynuilt Hotel.

This hotel near the mouth of the River Awe has fishings in a part of the Awe attached to it, in which 70 salmon and grilse were taken in 1891. The heaviest salmon was 24 lbs. The yellow trout fishing in the hotel waters is said to be falling off—cause unknown.

Invercauld Arms Hotel.

From this hotel upwards of 900 salmon, averaging 9 lbs. each, were caught in 1891. The heaviest salmon was 30½ lbs. The first clean salmon are taken in February; grilse and sea-trout run in June; and the main take of salmon is in April. It is stated that the Falls of Muick prevent salmon from ascending. There is good spawning ground above these Falls.

Invergloy Hotel.

From Invergloy Hotel, on Loch Lochy, I am informed that the number of fish has increased. About 200 lbs. weight of sea-trout were taken—heaviest sea-trout 4½ lbs.

Loch Tummel Hotel.

From Loch Tummel Hotel the number of fish has increased. Salmon were seen in the Loch in 1891, but none were taken. The largest yellow trout was 5 lbs., but the average weight was remarkable, being from 2½ to 3 lbs. There are no small trout, possibly owing to the number of pike in the Loch.

Bunessan Hotel.

Bunessan Hotel, in the island of Mull, did not do so well in 1891 as in 1890, owing to the dry weather in the spring, so that the fish could not get to the sea because of the smallness of the river. But, notwithstanding, 373 sea-trout, 7 salmon, and 2205 yellow trout were captured. The heaviest salmon was 7 lbs.; heaviest sea-trout 5 lbs.; and two heaviest yellow trout 4 and 5 lbs. April, May, and June are the best months for yellow trout. If the river is in good order, sea-trout and grilse run in July and salmon in August.

Culfail Hotel.

Culfail Hotel, in the beautiful Pass of Melford, is surrounded by a number of lochs, and it is stated that the trout are increasing in number but diminishing in size. The lochs are overstocked, and there is not enough feeding for the trout. The season lasts from 1st April till

end of September. 3153 yellow trout were caught during 1891—the heaviest weighing $2\frac{3}{4}$ lbs. The different lochs have been stocked for the last eleven years with Loch Leven and American brook trout from Howietoun Hatchery.

On the water belonging to the Breadalbane Hotel, the fishing was much as usual. 37 salmon, weighing 671 lbs., were caught in 1891, and 1090 trout weighing 359 lbs. The heaviest salmon was 28 lbs. and heaviest trout $1\frac{1}{2}$ lbs. The yellow trout fishing is increasing, owing to the lochs being stocked from Lord Breadalbane's Hatchery and not being much fished. A gauge is enforced—no trout being allowed to be basketed under 7 inches in length. Breadalbane Hotel.

From Rodono Hotel, near St Mary's Loch, it is stated that the fishing is much the same as it has been for the last five years. Some weeks as much as 80 lbs. of trout have been taken by anglers from the hotel. Salmon are rarely caught, but sea-trout up to 7 lbs. are got, and yellow trout up to 3 or 4 lbs. April, May, and June are the best months for yellow trout fishing. There is no Hatchery in the district, but Loch Skene was stocked four years ago with Loch Leven and American brook trout, which are doing well. Rodono Hotel.

In the Outer Hebrides, in South Uist and Benbecula, there are two hotels which are now well frequented during the fishing season. At Creagorry Hotel, in Benbecula, there is any amount of loch fishing. The sea-trout run up to 4 lbs. and the yellow trout to 2 lbs. The lochs are late—August and September being the best months both for sea-trout and yellow trout; there are no salmon. During 1891, the hotelkeeper opened up outlets to two lochs, the principal obstruction being walls built for the purpose of net poaching. There are said to be good and extensive spawning grounds in connection with various lochs, if proper outlets were made to the sea. The other Hebridean Hotel is at Loch Boisdale, in South Uist, where also the lochs are very late, the sea-trout not running until August. May and June, however, are good months for yellow trout fishing. The heaviest sea-trout in 1891 was $8\frac{1}{2}$ lbs., and the heaviest brown trout $4\frac{1}{2}$ lbs. Loch Bornish produces the finest yellow trout in the hotel waters. They are of the Loch Leven type. One gentleman, fishing it in 1890, caught 5 trout weighing $9\frac{1}{4}$ lbs. A close time is kept in the waters attached to the hotel from 31st October to 22nd February. Probably the finest sea-trout, or rather bull-trout fishing, in the United Kingdom is in the little River Howmore and its appurtenant lochs in South Uist. In two afternoons, many years ago, I took 48 sea-trout from the river with the fly; the river and lochs are strictly preserved. But I have now before me a paper sent me by a gentleman well acquainted with both river and lochs, in which he states that, in 1887, out of the pool opposite the rod-house on the Howmore, 1750 lbs. of large sea-trout were taken by the net one morning. He further states that, in different years, he fished the Howmore River and Loch twenty-three times, capturing altogether 475 sea-trout weighing $598\frac{3}{4}$ lbs., and 404 yellow trout weighing $128\frac{1}{2}$ lbs.; or a total of 879 trout of all kinds, weighing $727\frac{3}{4}$ lbs. Creagorry and Loch Boisdale Hotels.

The fishing from Loch Eck Hotel seems to have been fairly good in 1891, as 25 salmon weighing 254 lbs.; 8 grilse weighing 48 lbs.; 198 sea-trout weighing 396 lbs.; 5 *salmo ferox* weighing 26 lbs.; and 249 loch trout weighing 115 lbs. were captured. The heaviest salmon was 25 lbs.; the heaviest grilse, 8 lbs.; heaviest sea-trout, 4 lbs.; and heaviest loch trout, 5 lbs. Sea-trout run in May and June; salmon and herlings in July and August; and grilse in June and July. The best months for yellow trout fishing are from May till October. It is stated that the River Curr, which flows into Loch Eck, is very much poached all the year round. This, perhaps, is not to be wondered at, as there is Loch Eck Hotel.

no District Board for the Clyde, Leven, and Eckaig. There is a waterfall on the Corrente Burn—one of the best spawning burns on Loch Eck side.

There is much good spawning ground above the Fall which should be opened up by blasting.

Birnam Hotel.

The salmon fishings connected with the Birnam Hotel are said to have increased in 1891. 59 salmon were caught by anglers, the heaviest weighing 40 lbs.; also 6 sea-trout and 110 yellow trout. The main take of salmon is said to be in January, February, and October. The best month for yellow trout is April. Grilse and sea-trout begin to run about the end of April.

Danger of Over-fishing.

It will be seen from the above answers that several of the hotel-keepers are putting themselves to considerable trouble and expense, in artificially stocking the waters attached to their hotels, in order to supply the loss occasioned by the great number of fish killed by anglers during the fishing season. But the majority of them do not take this wise and necessary precaution; and it would be well for them to remember that, except in rare and peculiar instances, where there are large and deep lochs, such as Loch Laoghal and Loch Craggie, near Tongue Hotel, over fishing and free fishing, without any attempt to supply the annual destruction, must inevitably end in bad fishing or in none at all.

It ought to be mentioned that all the District Boards and all the hotel-keepers who have replied to the printed queries, are, with scarcely an exception, in favour of giving to District Boards, or to the Fishery Board for Scotland, compulsory powers, under certain conditions and restrictions, to open up the natural obstructions on the salmon rivers of Scotland.

THE FISHERY BOARD FOR SCOTLAND,
*Edinburgh*, 1*st March* 1892.

# NOTE I.

## ANNUAL CLOSE TIME APPLICABLE TO THE SCOTCH SALMON RIVERS.

**N.B.—Observe that, in the following List, the days fixing the commencement and termination of the Annual Close Time and of the Extension of Time for Rod-fishing are, in all cases inclusive, as in the case of the Add, the first River in the list.**

| Name of River. | Annual Close Time. | Extension of Time for Rod-fishing. |
|---|---|---|
| ADD, | From Sept. 1 to Feb. 15, both days inclusive. | From Sept. 1 to Oct. 31, both days inclusive. |
| ALINE, | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| ALNESS, | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| ANNAN, | From Sept. 10 to Feb. 24. | From Sept. 10 to Nov. 15. |
| APPLECROSS, | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| ARNISDALE (*Loch Hourn*), | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| AWE, | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| AYLORT (*Kinloch*), | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| AYR, | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| BAA AND GLENCOILLEADAR, | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| BADACHRO and KERRY (*Gairloch*), | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| BALGAY and SHIELDAG, | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| BEAULY, | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 15. |
| BERRIEDALE, | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| BERVIE, | From Sept. 10 to Feb. 24. | From Sept. 10 to Oct. 31. |
| BLADENOCH, | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| BROOM, | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| BRORA, | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| CARRADALE (*in Cantyre*), | From Sept. 10 to Feb. 24. | From Sept. 10 to Oct. 31. |
| CARRON, | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |

| Name of River. | Annual Close Time. | Extension of Time for Rod-fishing. |
|---|---|---|
| CLAYBURN, FINNISBAY, AVEN-NAN-GEREN, STRATHGRAVAT, NORTH LACASTILE, SCALLADALE, and MAWRIG (*East Harris*), | From Sept. 10 to Feb. 24. | From Sept. 10 to Oct. 31. |
| CLYDE and LEVEN, . . . . | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| CONON, . . . . . . | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| CREE, . . . . . . | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| CREED or STORNOWAY, and LAXAY (*Island of Lews*), . | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| CRERAN (*Loch Creran*), . . . | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| CROWE and SHIEL (*Loch Duich*), . | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| DEE (*Aberdeenshire*), . . . | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| DEE (*Kirkcudbright*), . . . | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| DEVERON, . . . . . | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| DON, . . . . . . | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| DOON, . . . . . . | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| DRUMMACHLOY or GLENMORE (*Isle of Bute*), | From Sept. 1 to Feb. 15. | From Sept. 1 to Oct. 15. |
| DUNBEATH, . . . . . | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 15. |
| EARN, . . . . . . | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| ECKAIG, . . . . . . | From Sept. 1 to Feb. 15. | From Sept. 1 to Oct. 31. |
| ESK, NORTH, . . . . . | From Sept. 1 to Feb. 15. | From Sept. 1 to Oct. 31. |
| ESK, SOUTH, . . . . . | From Sept. 1 to Feb. 15. | From Sept. 1 to Oct. 31. |
| EWE, . . . . . . | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| FINCASTLE, MEAVEG, BALLANACHIST, SOUTH LACASTILE, BORVE, and OBB (*West Harris*), | From Sept. 10 to Feb. 24. | From Sept. 10 to Oct. 31. |
| FINDHORN, . . . . . | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 10. |
| FLEET (*Sutherlandshire*), . . | From Sept. 10 to Feb. 24. | From Sept. 10 to Oct. 31. |
| FLEET (*Kirkcudbrightshire*), . . | From Sept. 10 to Feb. 24. | From Sept. 10 to Oct. 31. |
| FORSS, . . . . . . | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| FORTH, . . . . . . | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| FYNE, SHIRA, and ARAY (*Loch Fyne*), . | From Sept. 1 to Feb. 15. | From Sept. 1 to Oct. 31. |
| GIRVAN, . . . . . . | From Sept. 10 to Feb. 24. | From Sept. 10 to Oct. 31. |
| GLENELG, . . . . . . | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| GOUR, . . . . . . | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| GREISS, LAXDALE, or THUNGA, . . | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |

| Name of River. | Annual Close Time. | Extension of Time for Rod-fishing. |
|---|---|---|
| Grudie or Dionard, . . . | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| Gruinard and Little Gruinard, . | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| Halladale, Strathy, Naver, and Borgie, | From Aug. 27 to Feb. 10. | Close time for Rod-fishing from 1 Oct. to Jan. 10. |
| Helmsdale, . . . . . | From Aug. 27 to Feb. 10. | Close time for Rod-fishing from 1 Oct. to Jan. 10. |
| Hope and Polla or Strathbeg, . | From Aug. 27 to Feb. 10. | From Jan. 11 to Feb. 10, and from Aug. 27 to Sept. 10. |
| Howmore, . . . . . | From Sept. 10 to Feb. 24. | From Sept. 10 to Oct. 31. |
| Inchard, . . . . . . | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| Inner (*in Jura*), . . . . | From Sept. 10 to Feb. 24. | From Sept. 10 to Oct. 31. |
| Inver, . . . . . . | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| Iorsa (*in Arran*), . . . | From Sept. 10 to Feb. 24. | From Sept. 10 to Oct. 31. |
| Irvine and Garnock, . . . | From Sept. 10 to Feb. 24. | From Sept. 10 to Oct. 31. |
| Kennart, . . . . . . | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| Kilchoan or Inverie (*Loch Nevis*), . | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| Kinloch (*Kyle of Tongue*), . . | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| Kirkaig, . . . . . . | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| Kishorn, . . . . . . | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| Kyle of Sutherland, . . . | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 15. |
| Laggan and Sorn (*Island of Islay*), . | From Sept. 10 to Feb. 24. | From Sept. 10 to Oct. 31. |
| Laxford, . . . . . . | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| Leven, . . . . . . | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| Little Loch Broom, . . . | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| Lochy, . . . . . . | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| Loch Duich, . . . . . | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| Loch Luing, . . . . . | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| Loch Roag, . . . . . | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| Lossie, . . . . . . | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 15. |
| Luce, . . . . . . | From Sept. 10 to Feb. 24. | From Sept. 10 to Oct. 31. |
| Lussa (*Island of Mull*), . . . | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| Moidart, . . . . . . | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| Morar, . . . . . . | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |

| Name of River. | Annual Close Time. | Extension of Time for Rod-fishing. |
|---|---|---|
| Mullanageren, Horasary, and Loch-na-Ciste (*North Uist*), | From Sept. 10 to Feb. 24. | From Sept. 10 to Oct. 31. |
| Nairn, . . . . . . | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| Nell, Feochan, and Euchar, . . | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| Ness, . . . . . . | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 15. |
| Nith, . . . . . . | From Sept. 10 to Feb. 24. | From Sept. 10 to Nov. 15. |
| Orkney Islands (River from Loch of Stenness, &c.), | From Sept. 10 to Feb. 24. | From Sept. 10 to Oct. 31. |
| Ormsary (*Loch Killisport*), Loch Head, and Stornoway (*Mull of Cantire*), | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| Penygowan or Glenforsa, and Aros, | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| Resort, . . . . . . | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| Ruel, . . . . . . | From Sept. 1 to Feb. 15. | From Sept. 1 to Oct. 31. |
| Sanda, . . . . . . | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| Scaddle, . . . . . . | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| Shetland Islands (River of Sandwater, &c.), | From Sept. 10 to Feb. 24. | From Feb. 1 to Feb. 24, and from Sept. 10 to Nov. 15. |
| Shiel (*Loch Shiel*), . . . . | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| Sligachan, Broadford, and Portree (*Isle of Skye*), | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| Snizort, Orley, Oze, and Drynoch (*Isle of Skye*), | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| Spey, . . . . . . | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 15. |
| Stinchar, . . . . . . | From Sept. 10 to Feb. 24. | From Sept. 10 to Nov. 15. |
| Tay, . . . . . . | From Aug. 27 to Feb. 10. | From Jan. 15 to Feb. 10, and from Aug. 27 to Oct. 15. |
| Thurso, . . . . . . | From Aug. 27 to Feb. 10. | From Jan. 11 to Feb. 10, and from Aug. 27 to Sept. 14. |
| Torridon, Balgay, and Shieldag, . | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| Ugie, . . . . . . | From Sept. 10 to Feb. 24. | From Sept. 10 to Oct. 31. |
| Ullapool (*Loch Broom*), . . | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| Urr, . . . . . . | From Sept. 10 to Feb. 24. | From Sept. 10 to Nov. 30. |
| Wick, . . . . . . | From Aug. 27 to Feb. 10. | From Aug. 27 to Oct. 31. |
| Ythan, . . . . . . | From Sept. 10 to Feb. 24. | From Sept. 10 to Oct. 31. |

# NOTE II.

## PRINTED QUERIES SENT TO CLERKS TO DISTRICT BOARDS, PROPRIETORS OF SALMON FISHINGS AND THEIR FACTORS, LESSEES OF SALMON FISHINGS, AND OTHER PERSONS INTERESTED IN OR ACQUAINTED WITH THE SALMON FISHERIES OF SCOTLAND.

### Take of Fish.

Has the take of fish in your district increased or diminished? To what cause do you attribute such increase or diminution —

(*a*) In tidal waters?
(*b*) In fresh waters?
(*c*) In fixed engines?
(*d*) Generally throughout the district?

Can you give the number of fish caught in your district, exactly or approximately—

(*a*) By net and coble?
(*b*) By fixed engines?
(*c*) By rods?

At what period of the year in your district—

(*a*) Are the first clean fish taken?
(*b*) When is the main take of salmon?
(*c*) When do the grilse and sea-trout run?

What was the weight of the heaviest salmon or trout caught in your district in 1890—

(*a*) By net and coble?
(*b*) By fixed engines?
(*c*) By rods?

### Annual and Weekly Close Times.

1. Are the bye-laws regulating the observance of the annual and weekly close times by net and coble, and by stake, fly, and bag-nets strictly observed in your district? If not, can you suggest any means which would conduce to their stricter observance?

2. Is the period fixed for the commencement and termination of the annual close time in your district satisfactory? If not, what change would you suggest?

### Protection.

Is the system of protection in your district efficient? Are the men employed as river-watchers members of the County Constabulary Force, or are they employed by, and subject to, the District Board? State the number of water-bailiffs employed in your district.

## Illegal Fishing.

Is illegal fishing prevalent in your district? Were any prosecutions instituted under the Salmon Fishery Acts in 1891? If so, for what offences were they instituted, and what has been their result?

## Artificial Obstructions to the Passage of Salmon.

1. Mention the dams and cruives in your district, and state whether they are worked in accordance with the provisions of the bye-laws (Schedules F and G) regulating the same.

2. Are there salmon-ladders or passes on all the dams in your district; and if so, do they afford at all times a free passage to salmon wishing to ascend?

## Natural Obstructions to the Passage of Salmon.

1. Mention the natural obstructions in the shape of waterfalls in your district which prevent the ascent of salmon. State whether there are good and extensive spawning grounds above them, and give your opinion as to the best mode of opening up such spawning grounds, by attaching a salmon-ladder to the fall; by blasting it; or by a combination of the two methods.

2. At present, District Boards, under the 13th section of the Salmon Fisheries Act of 1868, have power to attach a fish-pass to a waterfall by agreement with the proprietor. There is no compulsory power, similar to that which is conferred, under certain conditions, on Boards of Conservators in England by section 49 of the Salmon Fisheries Act of 1873. Would you be in favour of giving such compulsory power; and if so, under what conditions and restrictions?

## Pollutions.

Are any of the streams in your district contaminated by pollutions? If so, mention them, state the nature of the pollution, whether it is increasing or diminishing, and also whether any steps have been taken by the polluters to neutralise the pollution before returning the water used by them into the river.

## The Salmon Disease.

1. Has the salmon disease shown itself in your district? If so, when did it first make its appearance? Has it attacked kelts only, or both kelts and clean fish? Is it increasing or diminishing?

2. Have you formed any opinion as to what has caused it, and what will prevent or cure it?

3. Do you think that there is sufficient provision made in the Salmon Fishery Acts of 1862 and 1868 to authorise District Boards to order their watchers to remove from the rivers and burn or otherwise destroy diseased fish; or do you think that more specific authority should be given in a future Act?

4. Generally, have you any remarks or suggestions to make with regard to the salmon disease?

### Artificial Propagation of Salmon.

Is there any Hatchery in your district for the artificial propagation of salmon and trout, either belonging to the District Board or supported by private enterprise? If so, describe its situation, and state how many fish can be hatched out in it annually.

### Proportion of Male to Female Salmon.

Can you state the proportion of the male to the female salmon in your district or river, specifying whether your return, so far as it goes, is based upon an estimate or on actual enumeration?

### Wild Birds Protection Act, 1880.

Do you think that the 'Wild Birds Protection Act, 1880,' which preserves a variety of birds—specified in the schedule attached to the Act—which destroy salmon and trout ova and fry, should be repealed as regards Scotland?

### General Question.

Are there any other points relating to the salmon fisheries in your district to which you wish to direct the attention of the Board, in addition to those suggested by the preceding queries?

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## NOTE III.

## PRINTED QUERIES SENT TO HOTELKEEPERS IN SCOTLAND HAVING SALMON OR TROUT FISHINGS ATTACHED TO THEIR HOTELS.

### Take of Fish.

1. Has the number of salmon, sea-trout, and yellow trout increased or diminished, of late years, in the rivers and lochs attached to your hotel? To what cause do you attribute such increase or diminution, as the case may be?
2. Can you give the number and weight of the salmon, sea-trout, and yellow trout caught by the rod in the hotel waters during the season of 1891?
3. What was the weight of the heaviest salmon, sea-trout, and yellow trout caught in your hotel waters during the season of 1891?
4. At what time are the first clean salmon taken? When do the grilse and sea-trout run; and when is the main take of salmon, grilse, and sea-trout?
5. What are the best months for yellow trout fishing in the waters attached to your hotel?
6. Is the average weight of the yellow trout in your hotel waters increasing or diminishing? To what cause do you attribute such increase or diminution, as the case may be?

## Artificial Breeding.

Is there a Hatchery in connection with the waters attached to your hotel? If not, has any attempt been made to stock the waters with Loch Leven trout, American brook trout, or Rainbow trout from Howietoun or other Hatcheries.

## Annual Close Time and Gauge for Yellow Trout.

At present there is neither an annual close time nor a gauge for yellow trout in Scotland. Do you think that it would be desirable to have such a close time or a gauge to prevent the basketing of too small trout? If you think so, state over what months the annual close time should extend, and also state what length you would fix for the gauge.

## Illegal Fishing.

Is there any illegal fishing in the waters attached to your hotel; or are they so efficiently watched as to prevent such fishing?

## Natural Obstructions to the Passage of Salmon.

1. Mention the natural obstructions in the shape of waterfalls in your district which prevent the ascent of salmon. State whether there are good and extensive spawning grounds above them, and give your opinion as to the best mode of opening up such spawning grounds, by attaching a salmon-ladder to the fall; by blasting it; or by a combination of the two methods.

2. At present, District Boards, under the 13th section of the Salmon Fisheries Act of 1868, have power to attach a fish-pass to a waterfall by agreement with the proprietor. There is no compulsory power similar to that which is conferred, under certain conditions, on Boards of Conservators in England by section 49 of the Salmon Fisheries Act of 1873. Would you be in favour of giving such compulsory power; and if so, under what conditions and restrictions?

## Wild Birds Protection Act, 1880.

Do you think that 'The Wild Birds Protection Act, 1880,' which preserves a variety of birds—specified in the schedule attached to the Act—which destroy salmon and trout ova and fry, should be repealed as regards Scotland?

## General Question.

Are there any other points in connection with the fisheries in the waters attached to your hotel to which you would wish to direct attention, in addition to those contained in the preceding queries?

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# NOTE IV.

## REPORT BY MR YOUNG, INSPECTOR OF SALMON FISHERIES ON A COMPLAINT MADE TO THE FISHERY BOARD FOR SCOTLAND BY THE DISTRICT BOARD OF THE RIVER AWE, OF AN ARTIFICIAL OBSTRUCTION IN THE LOWER PART OF THAT RIVER, ILLEGALLY INTERFERING WITH THE FREE PASSAGE OF SALMON TO THE UPPER WATERS.

EDINBURGH, 9TH DECEMBER 1891.

I have the honour to report that I have carefully read over and considered a letter to the Secretary of the Fishery Board for Scotland from the Clerk to the Awe District Board, complaining of an artificial obstruction to the free passage of salmon near the mouth of the River Awe, where the fishings belong to Mr Campbell of Lochnell.

There is a very close analogy between this obstruction in the Awe and that lately brought under the notice of this Board by the Spey District Board, which is situated on the Truim, and which was condemned by this Board at their last meeting as illegal. There are, of course, certain differences in detail in the two cases, but the principles which regulate and the laws which apply to both are identical; and I venture to think that this Board, after having condemned the obstruction on the Truim as an illegal interference with the channel of the stream, is bound to pronounce a similar judgment on the obstruction in the Awe.

That obstruction is thus described by Mr Macarthur, Clerk to the Awe District Board, in his letter of 28th November last :—'I have been 'instructed by the Awe District Fishery Board to report to you an 'obstruction which has recently been placed on the River Awe, and 'which my Board consider to be detrimental to the fishing of the district, 'in respect that it compels all the salmon ascending the river to pass over 'the netted ground belonging to Lochnell Estate, whereas a number of 'fish in the former state of the river were able to pass round by the 'stream that has been obstructed, and gain the River Awe at a point 'beyond where the nets are drawn.'

'The obstruction consists of a concrete wall 108½ feet in length, with 'an average breadth of 6 feet, the height running fron 2 feet 7 inches to 3 'feet. It is placed across a side stream from the main river, which flows 'round a piece of ground of about 3 acres in extent, forming it into an island 'between the two streams. It is on the river side of this island that the 'nets are principally drawn. Hitherto when the tide was in, a portion of 'the fish found their way up the river by the side stream and thus escaped 'the nets.

'It appears that from time to time a sort of causeway was put at the issue 'of the stream from the river so as to prevent the river itself diverging 'in that direction, but the present is the first occasion that so serious an 'obstruction has been placed there.'

From the above description, it is evident that, by purely artificial means, a channel by which salmon found their way to the upper waters has been entirely and throughly blocked up, and that all the salmon passing up the

river must now ascend by the other channel, which is constantly and systematically swept by the nets of the lessee of the salmon fishings. This, it humbly seems to me, gives an unfair advantage to the proprietor of these fishings, and is highly injurious to the upper proprietors on the Awe, Loch Awe, and the Orchy, the principal feeder of Loch Awe.

The following is a summary of the law with regard to artificial obstructions in rivers to the passage of salmon, as given by Mr Stewart in his 'Treatise on the Law of Scotland relating to Rights of Fishing.' On page 141 he writes :—'In a private stream, a person who is proprietor of the 'fishings and also of one of the adjacent banks, is entitled to make such 'use of the bank for the purpose of fishing or otherwise as he may think 'proper, but his power is subjected to the important limitation that no 'erections which he may make, and no operations which he may carry on, 'shall have the effect of altering the flow of the stream, to the possible 'damage of the opposite proprietor. The proprietors upon the opposite 'banks of a private river have a common interest in the stream, and 'though each has a right of property in the *alveus* from his own side up 'to the *medium filium fluminis*, neither is entitled to use the *alveus* in 'such a manner as to interfere with the flow of the stream. Erections 'on the bank which do not impinge upon the water cannot be objected 'to; but the slightest encroachment upon the stream may be resisted 'and put a stop to without the necessity of proving that damage has 'been or is likely to be sustained, for it is impossible to foretell what 'the result of it may be on the course of the river. And, for the same 'reason, if any objection be taken, the onus of proving that the Act is 'not an encroachment falls on the party making such encroachment, 'who is, *prima facie*, held responsible.' On page 149 he further writes : —'Obstructions, whether partial or total, have always been found to fall 'under the prohibitions ; and no kind of barrier to the progress of the 'fish, whether it rise above the surface of the water or not, will be per- 'mitted. It has even been found that placing a row of loose stones, not 'of any considerable size, in the bed of a river, not across it, but merely 'upon the edge of a pool, to facilitate fishing by net and coble, is illegal, 'though net and coble is the ordinary and legal mode of fishing ; the pro- 'hibitions extend also to all practices, either destructive to the breed of 'salmon or so noxious to their tastes and instincts as to deter them from 'ascending higher than suits the interests of the party using such 'practices.'

Lastly, on pages 167, 168, he writes :—'The general result of the 'statutes and decisions is, that all nets which are permanently or tempo- 'rarily fixed, and all erections, permanent or temporary (with the excep- 'tion of cruives possessed on a valid title), which form even a partial 'obstruction, or tend to frighten the fish, and are fixed either right across 'the river or at the side of it, are illegal. No length of possession will 'legalise a mode of fishing originally illegal, or authorise its continuance. 'Ingenuity might suggest various new and effectual modes of destroying 'salmon, applicable to the different situations in which the fish are to be 'found, and which might not be expressly prohibited by any statute 'or decision, but no such methods will be permitted if they come within 'the description of prohibited engines before defined ; *and it is no defence 'to an action for the removal of such contrivances, that the right to use 'them has been expressly conveyed by grant, or that they have been in use 'for the prescriptive period, or for time immemorial.* Damages may be 'recovered for loss caused by the use of illegal machinery or by the use 'of legal machinery in an illegal manner.'

I have underlined part of the last quotation, as Mr Macarthur, the Clerk

to the Awe District Board, in his letter complaining of the illegal obstruction, states that 'Mr George Woulfe Brennan, the factor for Lochnell, 'who caused the erection of the wall, maintains that the estate has a 'right to do so.'

I have only farther to mention that, when in Oban last month, I met Mr Campbell of Lochnell, and had a long conversation with him on the subject of the obstruction complained of by the Awe District Board. He stated that it had been put up by his factor without his knowledge whilst he was ill, and said that, in the event of its being considered illegal, he would be willing to remove it, and restore the channel to its former condition.

If, however, no amicable arrangement between the Awe District Board and Mr Campbell of Lochnell can be arrived at, and legal means must be taken to remove the obstruction, an action of Declarator and Removal would probably be the proper form of action. But in such a case, it seems clear to me that the action must be raised by the Awe District Board, and not by the Fishery Board for Scotland, as the second sub-section of the fifth section of 'The Fishery Board (Scotland) Act, 1882,' provides that 'The 'Fishery Board shall have the general superintendence of the Salmon 'Fisheries of Scotland, and shall have the powers and duties of Commis- 'sioners under the Salmon Fishery Acts, *but without prejudice to or inter- 'ference with the powers of District Boards.*'

I have the honour to be,

Your obedient Servant,

ARCH$^{D}$. YOUNG.

THE FISHERY BOARD FOR SCOTLAND.

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## NOTE V.

### THE RIVER CARRON 100 YEARS AGO.

From the account of the Parish of Kilsyth in the first *Statistical Account of Scotland*, which was published during the last decade of the 18th century, it appears that the Carron, now almost destitute of fish owing to pollutions and obstructions, was at that time a splendid fishing stream. The following is the statement with regard to it:—'The Carron, 'in its whole extent, from its rise till it reaches the Forth, is one of the 'finest rivers in Scotland. The quantity and size of the trout, the 'endless variety of pools and streams, and the openness of its banks, all 'concur in rendering it the favourite retreat of the angler, insomuch 'that people of all ranks, and from a considerable distance, resort to it in 'the fishing season; and there is scarcely a peasant or shepherd on its 'banks who is not eager in the pursuit of this amusement, and eminent 'in the art. Where the river is rapid and turbulent, and of a clear 'channelly bottom, the fishes are smaller and whiter after being dressed; 'but in the larger and deeper pools, especially so far as it is the boundary 'of this parish, where it is for the most part a large, deep, winding river, 'they are redder when dressed and darker when caught, and much larger 'in size. I have seen them 2, 3, and even 4 pounds weight, and from '18 to 24 inches long.'

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TENTH

# ANNUAL REPORT

OF THE

# FISHERY BOARD FOR SCOTLAND.

**Being for the Year 1891.**

*IN TWO PARTS.*

PART I.—GENERAL REPORT.
PART II.—REPORT ON SALMON FISHERIES.

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## PART II.—SALMON FISHERIES.

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Presented to both Houses of Parliament in pursuance of
Act 45 and 46 Vict. cap. 78.

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# TENTH ANNUAL REPORT

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**Being for the Year 1891.**

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**Being for the Year 1891.**

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## SECTION C.—CONTEMPORARY WORK.

# TENTH ANNUAL REPORT.

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TO THE MOST HONOURABLE

THE MARQUESS OF LOTHIAN, K.T.,

*Her Majesty's Secretary for Scotland.*

OFFICE OF THE FISHERY BOARD FOR SCOTLAND,
EDINBURGH, 28*th June* 1892.

MY LORD,

In continuation of our Tenth Annual Report, we have the honour to submit—

## PART III.—SCIENTIFIC INVESTIGATIONS.

### GENERAL STATEMENT.

This part of the Tenth Annual Report deals with the Scientific Fishery Investigations carried on by the Board during 1891. An account is also given of the fishery work and regulations in other parts of the United Kingdom, on the Continent, in America, and several of the Colonies.

The scientific work has been carried out, and the scientific report prepared under the superintendence of Dr T. Wemyss Fulton, F.R.S.E., Secretary for Scientific Investigations, acting under the direct instructions of the Board.

During 1891 the investigations were prosecuted on the same lines as indicated in last year's Report, and have resulted in further extensions of knowledge regarding the life-history and habits of the food-fishes, so far as these relate to fishery questions. A large part of the inquiries have been carried on by means of the Board's steam vessel the 'Garland,' under the efficient command of Captain R. E. Simpson; but the small size of this vessel has curtailed their usefulness.

Investigations have also been continued at the Board's Laboratories at Dunbar and St Andrews; on the development of the plaice, the sand-eel, and the rate of growth of fishes at the former, and on the halibut, saithe, pollack, torsk, &c. at the latter.

Professor M'Intosh, under whose able supervision the St Andrews Laboratory has been conducted since its commencement, has also, as in former years, courteously undertaken the study and description of the large collections of the eggs and young of the food-fishes made by the 'Garland;' and the Board desire to record their appreciation of the valuable assistance which has been rendered by Professor M'Intosh in connection with the Scientific Investigations for a number of years.

Physical observations on the temperature and density of the

sea have been made daily at ten fixed stations,—five on the East Coast and five on the West Coast,—and also on board the 'Garland,' the 'Vigilant,' and H.M.S. 'Jackal.'

### The Hatching and Rearing of Food Fishes.

As stated in last year's Report the Board have been impressed with the need of increasing the supplies of the food-fishes and shell-fish by means of artificial propagation and culture.

During the last six years a gradual falling off in the yield and value of the shore fisheries has occurred, and within the last few years the valuable flat-fishes have diminished in abundance to a very considerable extent, and very notably when the increase in the means of capture is taken into account. The quantities of turbot, brill, and plaice landed are becoming less yearly, although the number and tonnage of beam-trawl vessels have greatly increased within the same period. On the other hand, there has been a steady decline in the number of fishermen and fishing boats, and in the capital embarked in fishing boats and gear. There were 5573 fewer fishermen and boys last year than in 1885, and 2626 fewer boats; and the capital embarked in fishing boats and gear (exclusive of trawlers) has diminished from £1,485,929 in 1889 to £1,415,530 in 1891,—a fall of over £70,000 in three years. That the valuable flat-fishes are also diminishing in numbers is shown by the figures, indicating the number of hundred-weights of those fish caught by beam-trawlers per ton of the vessels engaged, and which are given later. The decrease has been greatest among turbot, but it has taken place with all kinds of flat-fish.

The trawling experiments of the 'Garland,' referred to later, show that little or no increase has occurred in the abundance of flat-fish within the territoral waters from which the practice of beam-trawling has been prohibited; and the special statistics of the quantities of fish taken by line fishermen from the inshore grounds also show that a falling off has occurred.

Such diminution in the supply of the food-fishes relative to the means of capturing them is not peculiar to the Scotch coast. Complaints have for some years been made of depletion of the fishing grounds off the English coast, and off the coasts of maritime States in Europe and America—wherever, indeed, sea-fishing has been industriously prosecuted on a large scale for a long period. Hence, in many of these countries, besides the enforcement of restrictive regulations, sea-fish hatcheries have been erected with the view of increasing the supply by artificial culture. Such establishments exist in the United States, Norway, Newfoundland, and Canada. In the country first named, the great fishery for shad, which had sunk to a very low point, has been revived by such means, so that it yields larger returns than ever before. So, also, in Norway, where for a number of years a sea-fish hatchery has been in successful operation at Flödevig, near Arendal, and another is now in process of being established in Christiania Fjord, larger and more fully equipped than its predecessor. During the present hatching season, 207,000,000 young cod were hatched at the

Flödevig Institution, and planted on the fishing grounds. At the Newfoundland hatchery, also, operations are conducted on a large scale, 39,650,000 of young cod and 551,469,880 of young lobsters having been hatched and set free on the fishing grounds during the course of last season.

Last year it was decided by the Board that a similar hatchery for sea-fish should be erected at Dunbar, where a suitable site and sea-creek were available, and which is situated in proximity to the large closed area of the Firth of Forth. From this area beam-trawling has been excluded since 1886, and for the same period careful statistics have been collected as to the fish caught within that area, and periodical examinations of the fishing grounds made. Hence, no place could be more suitable to study how best to increase the supply of the food-fishes by culture, inasmuch as the grounds are under control and the present abundance and distribution of the fish are known.

As a preliminary step, Dr Fulton was requested to visit the Norwegian sea-fish hatchery, which is referred to above, and subsequently the experience and advice of Captain G. M. Dannevig, the Director of that establishment, were obtained. At the invitation of the Board, Captain Dannevig made an inspection and examination of the site of the proposed hatchery, the sea-creeks adjoining, and the natural conditions in relation to hatching work, and reported favourably. The Board thereupon decided to proceed with the formation of a hatchery, so far as the means at their disposal would permit; and that the system of Captain Dannevig, the success of which had been proved in the course of years in Norway, should be adopted at Dunbar. Plans for a large spawning pond were prepared by Messrs Strain, Robertson, and Thomson, C.E., and Captain Dannevig kindly undertook the supervision of the construction of the hatching-house and hatching appliances in Norway.

The hatching-house, which is now erected at Dunbar, consists of a substantial double-walled wooden building, thirty-five feet long by twenty-four feet broad, with interior space for sixteen hatching boxes, capable of containing at one time 80,000,000 eggs; and it has been placed so that it will be possible, subsequently, to extend it to three times the size within the limits of the ground at the disposal of the Board. The spawning pond in which the ripe fish are contained at the spawning time is also completed, and consists of a large concrete tank sunk in the ground, with a capacity of 60,750 gallons. For pumping the large supplies of sea-water necessary, an 8-horse power locomotive steel boiler and two Worthington direct-acting steam pumps have been obtained; each pump being capable of throwing over two thousand gallons of sea-water per hour when working at minimum speed, and over three thousand gallons per hour at maximum speed. It is intended to arrange the supply-pipes so that the water may be pumped directly from the sea or from the creeks which it is proposed to enclose.

The whole of the above work will be completed during the present summer, and operations may therefore be commenced at the next spawning season. It may be pointed out that, while the present number of hatching boxes will allow about 80,000,000 of fish-eggs to be manipulated at one time, many times this quantity can

be dealt with in succession in the course of one season; and that the boiler and pumps have been selected in view of the extension of the hatchery later to three times its present size, for which they will be amply sufficient.

The whole of the expenditure in connection with the above undertaking has been met from the ordinary vote for Scientific Investigations. The Board, however, regret that this source is not sufficient for the enclosure of the adjacent sea-creeks, which is essential for the success of the hatching operations. Experience at existing hatcheries has made it clear that it is impossible to obtain a sufficient number of living spawning fish at the proper season for the supplies of ova required, unless the fish are gradually collected and acclimatised in a sea-pond until wanted. Many hundreds of spawners are needed, and hence an indispensable adjunct of a sea-fish hatchery is the possession of a tidal pond or ponds in which to retain the adult fish from season to season, and which may be used for the rearing of the fry to a certain size.

At Dunbar certain natural creeks are admirably adapted for this purpose. Messrs Strain, Robertson, and Thomson, the engineers who have surveyed these creeks, and drawn up plans for their enclosure, report as follows:—

> 'We have examined and surveyed the natural sea-creeks at 'Dunbar in connection with the hatchery and tank at present 'in course of construction there, and beg to report that, if these 'creeks were enclosed by concrete walls as proposed, and for 'which we prepared plans, the total superficial area within 'those walls would be 13,545 square feet at high-water of 'ordinary spring tides.
>
> 'The area of the West creeks is about 5,800 square feet, 'and that of the East creek about 7,655 square feet.
>
> 'When filled by ordinary spring tides, these creeks would 'contain about 560,000 gallons of water at high-water, and 'would have a maximum depth of 14 feet in the West creek, 'and 16 feet in the East creek.

As stated in last year's Report, it is understood that a sum of £1,500 would be sufficient to enclose these creeks, and the Board again express the hope that this sum will be placed at their disposal for the purpose, and thus enable them to proceed on the largest possible scale with the hatching and rearing of the valuable food-fishes.

At the lobster pond which, as stated in last year's Report, has been constructed at Arran, and was stocked with berried females, about 200,000 ova were hatched during last season.

The following is an account of the more important investigations which have been undertaken during the year:—

## The Influence of Beam-Trawling.

### *The Trawling Experiments of the 'Garland.'*

The experiments of the 'Garland' as to the relative abundance of the various species of the food-fishes in the territorial waters where trawling is prohibited, and in the adjoining areas where it is

allowed, were continued during the year as before. A special Report on this subject, with tables giving in detail the results of the examination of the various trawling stations, will be found under Section A.

In the course of the year the various stations in the Firth of Forth, St Andrews Bay, Aberdeen Bay, Montrose Bay, and in the Moray Firth were examined, the stations being tested on 156 occasions, as compared with 135 in the previous year. In addition to the periodic examination of the trawling stations, a number of special hauls were made at other times, and along selected lines, especially on the offshore grounds, for the purpose of ascertaining as much as possible regarding the occurrence and distribution of ripe fish, their floating eggs and young, &c.

In regard to the results of the trawling experiments last year, it is necessary to limit consideration to the areas of the Firth of Forth and St Andrews Bay; since the 'Garland,' from its small size, can scarcely venture along the northern portion of the East Coast, except in settled weather in summer, and hence it is not possible to examine the stations off Aberdeen and in the Moray Firth as frequently as is desirable. In the Firth of Forth area, the stations were examined on 108 occasions in the course of the year, 84 of these being within the closed waters where beam-trawl fishing is prohibited, and 24 at the stations lying beyond it, where it is freely prosecuted. As a general result, it was found that a considerable decrease occurred in the total quantity of fish captured per haul of the net within the closed waters, as compared with the previous year. This decrease was owing to diminution in the abundance of round-fish, these fish having been exceptionally numerous in the year preceding. There was a slight increase in the number of flat-fish, as compared with 1890. In the open waters off the Firth of Forth there was a decrease in round-fish and flat-fish, the decrease in round-fish being specially marked.

In the St Andrews Bay area, the result of the examination of the stations shows that there was also a very large decrease in 1891 in the quantity of fish captured per haul of the net, when compared with the preceding year. This diminution was almost confined to flat-fish, which frequent St Andrews Bay in large numbers, the mean quantity having fallen from 303 in 1890 to 109 in 1891. The numbers of plaice, especially, were much diminished.

The trawling experiments in the areas referred to have now been carried on for six years, and in the special Report will be found an analysis of the results during that period. Considerable fluctuations have occurred from year to year in the quantities of both round-fish and flat-fish captured,—due, no doubt, to a large extent to general conditions of weather and so forth, which affect sea-fisheries everywhere. But, although the period, for this reason among others, during which the observations have been continued is not sufficient to justify any certain conclusions, it may be pointed out that up to the present the increase in the abundance of flat-fish within the closed areas has not been such as was anticipated. When the mean catch for the first three years is contrasted with the mean catch for the last three years, the following results are brought out:—

| Years. | Flat-Fish. | Round-Fish. | Total. |
|---|---|---|---|
| 1886–1888 | 190·6 | 148·1 | 338·6 |
| 1889–1891 | 154·7 | 155·0 | 309·7 |

These figures indicate that within the closed area flat-fish have, on the whole, diminished rather than increased; but in considering this fact it is necessary to bear in mind, on the one hand, the results of certain concurrent investigations carried out on board the 'Garland,' and, on the other hand, the greatly increased development of beam-trawling in recent years. It has been shown, by the researches of the 'Garland,' that the great majority of the food-fishes—cod, haddock, whiting, plaice, lemon soles, &c.—either do not spawn at all within the closed area referred to, or only to a slight extent in the case of some forms. The adult fish, when mature, leave the territorial waters and congregate at the spawning time beyond the three-mile limit, where the eggs are cast forth in myriads and are gradually floated in vast numbers towards the shallow water. It is among these offshore spawning shoals that trawlers work on a large scale, and it is obvious that if the adult fish are captured on the breeding grounds in greatly increased numbers before they have spawned, the supply of young fishes for the inshore waters must be materially reduced. It may be said, as the result of four years' continuous investigations, that none, or scarcely any, of the plaice, lemon soles, cod, haddock, or turbot to be found within the waters of the Firth of Forth or St Andrews Bay were born there. They have been floated in at an early stage of their existence, or have migrated thither at a later period. It has been also shown by the investigations made on board the 'Garland' that, while immature fish of certain kinds are most abundant within the three-mile limit, the majority are to be found without that limit.

It is of great importance that these offshore spawning grounds, which form the great source of supply for the inshore waters, should be carefully and thoroughly investigated; but the 'Garland' can only visit them rarely in exceptionally favourable weather.

### *Special Fishery Statistics.*

The fishery statistics relating to the trawling experiments, and showing the productiveness of the territorial waters, &c., are found in detail in the special report previously referred to. The decline in the number of fishing boats and fishermen adverted to in the Ninth Report continued in 1891, there being in the latter year, as compared with 1890, a decrease of 433 fishing boats, 94 of them first class boats, and of 1626 fishermen. The number of beam-trawlers, on the other hand, increased from 118, of a gross tonnage of 4705 tons, in 1890 to 132, of a gross tonnage of 6484, in 1891.

In regard to the quantities of fish landed, special returns have been obtained from five districts comprising that portion of the East Coast between Dunbar on the south and Aberdeen on the north, and including both these places. The quantity of fish landed on this portion of the coast last year by line fishermen and

beam-trawlers was 759,440 cwts., compared with 739,071 cwts. in 1890, or an increase of 20,369 cwts. This increase was principally in round-fish, but there was also a very slight increase in flat-fish. In 1890 the quantity of flat-fish was 100,389 cwts., against 101,935 cwts. last year, showing an increase in 1891 of 1546 cwts. The quantity of round-fish in 1890 was 638,682 cwts., against 657,505 cwts. in 1891, or an increase of 18,323 cwts. in the latter year.

The increase in the quantity of white-fish landed in these districts during 1891 was entirely due to the operations of beam-trawlers, a large falling off in the quantities landed by line fishermen having taken place. In 1890, line fishermen landed 28,170 cwts. of flat-fish and 430,070 cwts. of round-fish, or a total of 458,227 cwts. Last year they landed 25,587¾ cwts. of flat-fish and 418,281 cwts. of round-fish, or a total quantity of 443,868¾ cwts. These figures indicate a total decrease in line-caught fish of 14,358 cwts.; the decrease in flat-fish being 2582 cwts. and in round-fish 11,776 cwts.

On the other hand, the quantity of fish landed by beam-trawlers increased by 34,728 cwts.; the gross quantity in 1890 being 280,844 cwts., compared with 315,571¾ last year. In 1891, beam-trawlers landed 76,347¼ cwts. of flat-fish and 239,224½ cwts. of round-fish, as against 72,219 cwts. of flat-fish and 208,625 cwts. of round-fish in 1890, showing an increase last year of 4128 cwts. of flat-fish and 30,599 cwts. of round-fish.

The statistics of the quantities of fish captured by line-fishermen in the territorial waters of the East Coast, from North Berwick on the south to Skateraw, a few miles south of Aberdeen, on the north, have also been tabulated, and the monthly and yearly averages per 'shot' for each kind of fish enumerated given. During last year there was an increase in the number of 'shots' in this portion of the territorial waters and in the quantity of fish landed, compared with the previous year.

In 1890 the number of 'shots' was 34,501, and the quantity of white-fish (excluding herrings) captured was 83,692¼ cwts., giving an average of 2·425 cwts. per 'shot.' In 1891 the number of 'shots' was 37,928, and the quantity of line-caught fish was 92,469 cwts., or an average per 'shot' of 2·438 cwts.

The statistics showing the number of 'shots' in the territorial waters, the quantity of line-caught fish obtained, and the average quantity per 'shot' for the past four years, are as follows:—

| Year. | Total Trips or Shots. | Quantity of White Fish caught. cwts. | Average Quantity per Shot. cwts. |
|---|---|---|---|
| 1888 | 43,077 | 109,396½ | 2·539 |
| 1889 | 42,898 | 107,029¼ | 2·494 |
| 1890 | 34,501 | 83,692¼ | 2·425 |
| 1891 | 37,928 | 92,469 | 2·438 |

In regard to the kinds of fish, there was an increase in 1891 in cod, haddock, and other white fish, and a decrease in flat-fish and whiting. The quantity of flat-fish (lemon soles, flounders, dabs,

turbot, and skate) caught by line-fishermen within the territorial waters of the Leith and Anstruther districts (the Firth of Forth and St Andrews Bay) last year was 5131½ cwts., compared with 6799½ cwts. in 1890, or a decrease of 1668 cwts. The average or mean catch of fish per 'shot' of the line in the territorial waters, along the part of the coast referred to, was, in the period 1888–89, 2·516 cwts., the total number of 'shots' of the line being 85,975. In the period 1890–91, with 72,429 'shots,' the average or mean catch was 2·431 cwts.

## The Spanish Sardine Industry.

The sardine, which is the young of the pilchard, is not now a regular inhabitant of the Scottish seas, although a stray individual may possibly be occasionally obtained. In response to inquiry the Fishery Officers of fourteen of the seventeen East Coast districts say that pilchards are never landed in their districts. A stray specimen may be got occasionally in the Moray Firth, off the Firth of Forth, or in the Firth of Clyde. Six or seven years ago, a few were caught at Cromarty and near Skye, on the West Coast; but, as has been said, the pilchard cannot be considered a denizen of Scottish seas. Yet there is authentic evidence that the pilchard was at one time quite a common fish on the East Coast of Scotland. As late as the beginning of the present century they were as abundant at some places as the herring; and this gave rise to complaints by the herring-curers, when quantities of the pilchard were delivered to them mixed with the herrings.

But, as is well known, large quantities of other fish are prepared on the Continent and in America as sardines, and sold as such —and this is especially so with the sprat and young herrings. Since these fish are abundant on the coasts of Scotland, the Board requested Mr W. Anderson Smith, one of its members, to proceed to Spain to investigate the modes of preparation of the sardine at the great seats of the industry in that country, and to ascertain the possibilities of establishing a trade in Scottish herrings, which are at present practically shut out from Spanish markets. The results of this inquiry are given in the present Report. Mr Smith describes the fishery for sardines, as carried on both in Spain and France, and discusses various points regarding the natural history of the fish, which has recently received much attention. On the Galician coast the fishery is carried on by great seine-nets, 650 yards long and 33 deep, which sometimes enclose vast numbers of pilchards. The process of cure and preparation are also explained. Very large quantities of fish, up to seven inches in length, are prepared, not in tins with oil, as is the case with the ordinary sardine of commerce, but by salting, and pressing into barrels or kegs, as in Cornwall; and Mr Smith is of opinion that well-packed, well-cured Scotch herring of medium size, such as 'maties,' would compete satisfactorily with those Spanish fish, if they were prepared for keeping in a hot climate. The sizes of the barrels used and the prices obtained are given, and it is stated that the fine large Scotch

herring, thoroughly well cured and well-packed in sound barrels, to meet the Spanish market, if properly introduced, should find itself without any real competitor, but it must stand carriage and keep through the hot weather. Mr Smith explains that the supplies of dried cod-fish, which is extensively consumed in Spain, are now almost entirely derived from Norway, the Norwegian fish being frequently sold as Scotch—*bacalao de Escocia.* The Scotch cured cod, although greatly superior, appear not to keep so well as those from Norway.

## Over-Fishing of the Sea and Sea-Fish Culture.

As stated, for a number of years complaints have been made as to a falling off in the supplies of certain fish, especially the valuable flat-fish, such as turbot, brill, soles, halibut, &c., and in the present Report Dr T. Wemyss Fulton gives the results of an inquiry made into the subject of over-fishing. The historical aspect of the question is divided into three phases or periods. It is pointed out that the early Scottish records do not refer to over-fishing or injurious fishing in the sea, except occasionally in connection with the herring fishery at certain places, or in estuaries; and that no Acts of the Scots Parliaments were passed dealing with this aspect of the fisheries, as was the case in the early Parliaments of England. The restrictive fishery legislation of last century, and the earlier part of this, so far as it applied to Scotland, almost exclusively affected the herring fishing. This period terminated some thirty-five years ago, when the movement which led to the Liberating Act of 1868 began; while during the past few years there has been a recurrence to restriction and interference with the mode of fishing.

From the statistical point of view, Dr Fulton shows, by a study of the fishery statistics since the establishment of the Board of British White Herring Fishery in 1809, the enormous development of the Scotch fisheries, especially on the East Coast. The average or mean of each quinquennial period is taken, and these prove that from 1825 (when the number of fishermen and fishing boats was first given) to 1886, there was a steady and almost continuous increase in the number of boats and men engaged in the sea-fisheries; whilst from 1886 onwards to last year, there has been a steady and continuous decline. The increase has been relatively greater in the number, and especially in the tonnage, of the boats, than in the number of fishermen. In 1825–29, the mean annual number of men employed was 37,457, as compared with 49,160 in the period 1885–89—an increase of 11,703. Last year the number was only 46,337. The boats increased from a mean of 8,921 in the first quinquennial period, to a mean of 14,494 in the last period, the number last year being 13,801. The tonnage and values have increased in even greater ratio, as has also the extent of netting employed in the herring fishery and the length of the lines. Tables are given showing the mean tonnage, values, and quantity of fishing gear in each quinquennial period for the last 47 years,

and also, throughout the same period, the number and tonnage of the boats, their value, the quantity of netting and lines, and the total value of boats and gear *per hundred* of the fishing population. From these tables it appears that while forty-five years ago each Scottish fisherman was, on an average, equipped with 1306 square yards of herring netting, and 142 fathoms of lines, and had £13, 4s. 9d. of capital embarked in his boats and gear, in the later period he was equipped with 3917 square yards of netting and 724 fathoms of lines, the capital sunk in his boats and gear being £32, 17s. 4d. In 1890–91 the quantity of netting possessed by each fisherman was 3667 square yards, the length of lines 768 fathoms, and the total capital £30, 14s. 9d.

It is pointed out that this immense development has been almost entirely confined to the East Coast, where the quantity of the fishing gear has been enormously increased; and that, while previously the fisheries were almost exclusively carried on in the Firths and near the coasts, the fishermen are now compelled to go further and further to sea, in the search for more productive grounds. Comparison is also made between the amount of the machinery of capture and the quantity of fish caught, as far as the imperfect statistics allow.

The statistics relating to beam-trawling are separately considered, and it is shown that, whilst the number, tonnage, and value of beam-trawlers are increasing, there is a decrease in the quantity of prime fish caught, and a very serious decrease when compared with the tonnage of the vessels. Thus, in the four years for which statistics are available, the number of hundred-weights of flat-fish captured by beam-trawlers per ton of the vessels' tonnage is as follows:—

| 1888 | 1889 | 1890 | 1891 |
|---|---|---|---|
| 24·9 | 19·3 | 16·7 | 12·4 |

The measures taken in other countries, Norway, the United States, Newfoundland, and Canada, by the establishment of sea-fish hatcheries, are explained, and the hatchery in process of completion at Dunbar is described.

## The Bait Fisheries.

As stated in previous Reports, the mussel-beds at various parts of the Coasts of Scotland are in an unsatisfactory condition, and it is upon the supplies of mussel-bait from these beds that line fishermen mainly depend. The quantities of Scotch mussels landed for the past nine years are as follows:—

| | | | |
|---|---|---|---|
| 1883 | 14,078 tons | 1888 | 12,481 tons |
| 1884 | 12,467 „ | 1889 | 9,441 „ |
| 1885 | 12,213 „ | 1890 | 9,058 „ |
| 1886 | 13,063 „ | 1891 | 11,558 „ |
| 1887 | 13,814 „ | | |

From these figures it will be seen that the quantity of mussels landed from Scotch mussel-beds has decreased to a considerable extent in recent years. The increase shown last year occurred both on the East Coast and the West Coast, but was mainly owing to a very large augmentation in the quantity obtained from the important mussel-beds in the Clyde. In 1890, these beds yielded only about 750 tons, while last year they furnished about 2550 tons of mussels, or an increase of 1800 tons, almost all of which were used for bait.

In this Report Dr J. H. Fullarton gives the results of an examination made into the present condition of the Clyde beds. The relative abundance and character of the mussels distributed on the different banks are described, and it is shown that overfishing has in past years occurred to an injurious extent, and that by a proper and rational system of culture these beds might be made to yield a very large and constant supply of bait for fishermen from year to year. Lists are given of the pelagic and bottom fauna, especially of the Crustacea, and a chart accompanies the paper, showing the present extent and limit of the various beds.

The clam beds in the Firth of Forth continue to supply large and increasing quantities of a valuable bait, which is now largely used at various parts of the East Coast, as well as at the fishing villages in the neighbourhood. In 1886 these beds yielded 9,100 cwts., valued at £1,256, while last year they supplied 28,512 cwts., or 1,425 tons, valued at about £3,350, showing an increase from the previous year of 2,765 cwts. in quantity, but of only £39 in value.

There is as yet no evidence to show whether the increase in the supply of clams from the Forth beds is due simply to greater productiveness or to over-fishing, as has happened with so many bait-beds.

During the ensuing summer it is proposed to transport clams, prior to the breeding season, to selected localities further up the coast, with the view of establishing beds of this valuable bait in proximity to the fishing stations at which line fishing is extensively prosecuted.

## Inquiries into the Food, the Reproduction, Habits, and Migrations of the Food-Fishes.

During the past four years continuous investigations have been carried on respecting the food, spawning, migrations, &c. of the food-fishes, in accordance with a system devised by Dr T. Wemyss Fulton early in 1888. These inquiries have been prosecuted on board the 'Garland,' with the view of ascertaining as much as possible concerning the habits and life-histories of sea-fishes, for the purpose of judicious regulation and conservation of the food supply. In several other counties similar inquiries have been organised, and are now being carried on in a systematic way, and have yielded results of great value. Hitherto the investigations have been almost exclusively confined to inshore waters for the reason previously given—the small size of the 'Garland,'—but

there is no doubt that if it were possible to extend them to the great offshore fishing grounds, from which the bulk of the fish supply is obtained, their value would be greatly increased.

## The Food of Fishes.

The inquiries into the nature of the food of the edible fishes have now been carried on for four years, in connection with other investigations, and in the present Report an account is given by Mr W. Ramsay Smith, M.B., C.M., B.Sc., of the results obtained in 1891—and also an analysis of the whole of the information collected since the inquiries were begun. The species of food upon which the various kinds of round-fish and flat-fish subsist has been determined with great care by Mr Thomas Scott, F.L.S., the naturalist on board the 'Garland,' who has kept the records of the contents of the stomachs of all the fishes examined—a number now amounting to about twenty thousand. Mr Ramsay Smith gives in his Report full details of the food of each species of fish, and shows that mere lists of the various kinds of organisms upon which fishes prey convey but little information as to the food material upon which they really subsist. Thus it appears that while a species may prey upon a very large number of organisms, its existence depends upon two or three, which constitute the great bulk of its food; the others being only captured occasionally. The determination of this fact is of much importance. It is also found that there is much less competition for the same organisms between the various species of fish than had been supposed.

## Additions to the Fauna of the Firth of Forth.

In connection with the inquiries on the distribution of the organisms which form the food of fishes, Mr Thomas Scott, F.L.S., has, for a series of years, made special investigations of the fauna of the Firth of Forth, and gives in the present Report his fourth contribution on this subject. Previous to 1887, about 120 species of Crustacea had been recorded for the Firth of Forth; but, as a result of Mr Scott's painstaking labours, this number has now been increased to over 400. In his present Report, he describes over thirty species of Crustacea chiefly belonging to the Copepoda, upon which the herring and mackerel largely subsist. Fifteen of these are new to science, and the rest have not been previously found on the East Coast of Scotland. A large number of the new forms were obtained at the well-known fishing ground—the 'Traith' or 'Fluke Hole,' off the coast of Fife. Mr Scott's paper is illustrated by seven plates.

## The Reproduction, Maturity, and Sexual Relations of the Food-Fishes.

In previous reports papers have appeared on the investigations as to the spawning and propagation of the food-fishes. In the present Report, Dr T. Wemyss Fulton deals with the collective results of

the inquiries made during the last four years, the records of which have been made chiefly on board the 'Garland' by Mr Thomas Scott, F.L.S., and partly by the Fishery Officers at various parts of the coast.

From the examination of many thousands of specimens during the time indicated, it has been possible to determine with considerable accuracy the limits and duration of the spawning period of the majority of the food-fishes, and the areas in which the spawning fish are found on the East Coast, and those from which they are absent. The great majority spawn in spring, but some not until well on in summer, and the duration of the spawning season varies in different species, but generally extends over about three months. The earliest to spawn are the saithe, plaice, and haddock; the cod is slightly later than the haddock, and the whiting and ling later still. Tables and a chart are given, showing the spawning season for the more important of the food-fishes; and it is shown:—(1) that in a given locality, on the same spawning ground, successive shoals of the same species of fish may arrive, spawn, and depart in one spawning season; (2) that the shoals nearest the coast spawn, as a general rule, earlier than those remote from land; (3) that fish generally spawn earlier on the West Coast than on the East Coast; and (4) that spawning fish of many species—turbot, brill, ling, cod, tusk, saithe, &c., may be found from 50 to about 200 miles from shore. The result of continued inquiries, now extending over four spawning seasons, confirms what was stated in last year's Report, namely, that the majority of the important food-fishes do not spawn within the territorial waters on the East Coast of Scotland, where the investigations were carried on, but outside the limits of exclusive jurisdiction. Not a single cod, haddock, or plaice, with the reproductive organs fully matured has been captured by the 'Garland' within the Firth of Forth, St Andrews Bay, or other parts of the territorial zone. On the other hand, a few whitings, fewer lemon soles, and considerable numbers of gurnards, dabs, and flounders may spawn within the three-mile limit. Professor M'Intosh notes that the majority of the floating ova of the turbot, found in St Andrews Bay in May and June, have the embryonic fish far advanced in development, apparently indicating that they had been carried by currents a considerable distance.

The sizes at which the males and females of the various species reach maturity are also given in tabular form, together with an account of the relative proportions and sizes of the sexes.

## The Migrations of the Food-Fishes.

The experiments on the migration of fishes were continued last year, and nearly 3000 individuals have now been marked and returned alive to the sea. A considerable number of these have been subsequently captured, at periods varying from a month or two to twenty-seven months, from the time of being set free. As a rule, it was found that the distance between the place where they were captured, and the place where they were put into the sea, was not great,—in some cases they were

practically the same—the inference being that the fish had not travelled far in the interval. In some cases the marked fish had travelled considerable distances; plaice, which had been in the water for over seventeen months, having been caught eighteen miles, and codling twelve miles from the place of liberation, within two months afterwards. In St Andrews Bay there appears to be a fairly regular movement of small and medium-sized plaice northwards towards the Tay. These fish pass outwards on attaining sexual maturity, and probably spawn somewhere in the neighbourhood of the Bell Rock.

From the ignorance which prevails as to the migrations of the herring, and the importance of ascertaining definitely the movements of this fish, in relation to the great spawning and fishing grounds, the Board have decided that similar experiments should be made in connection therewith, and these were begun by Dr T. W. Fulton at the Ballantrae Bank in the spring of the present year.

### The Development and Life-Histories of the Food and other Fishes.

During last season considerable and important additions were made to our knowledge concerning the nature of the spawn of the food-fishes, the development of their young, and the distribution of the ova and young. In the present Report, Professor M'Intosh, F.R.S., gives the results of his researches on these subjects. The very large collections of pelagic ova and larval and post-larval fishes made by the 'Garland' and by the boat of St Andrews Marine Laboratory, have been identified and described, the relative abundance at each station of the eggs of the various species of fish, and the stage of development which they had reached, being carefully noted.

During last season Professor M'Intosh has been able to identify and describe the pelagic eggs of no less than six species of the food-fishes, namely, the halibut, torsk, saithe, lythe, megrim, and poor-cod, and to clear up many doubtful points regarding several others. The important fact has been proved that the ripe ova of the halibut, unknown previous to the present year, float at the surface of the sea, like those of other flat-fish. They are, indeed, the largest of all the pelagic ova hitherto described, but they do not appear to have been ever obtained in the tow-nets. Professor M'Intosh has also been able to hatch the artificially fertilised eggs of the torsk, the megrim, the brill, and the poor-cod, and in the present Report the development of the embryo in each of these forms is described. He has also cleared up much that has hitherto been obscure respecting the identity and distribution of young specimens of the turbot, brill, and other flat-fish. Four Plates accompany Professor M'Intosh's paper.

Professor E. E. Prince and Dr J. Lindsay Steven have made an examination of two remarkable tumours, one found in a haddock and the other in a cod, and their paper dealing with this inquiry is found in the present Report.

CONTEMPORARY FISHERY WORK.

An account is given in Section D, by Dr T. Wemyss Fulton, F.R.S.E., of the contemporary fishery work in Great Britain, Ireland, Canada, Newfoundland, the United States, New South Wales, Norway, Sweden, Denmark, Germany, Holland, Spain, and Italy.

From this review of contemporary sea-fisheries in other countries, it appears that there is a general complaint as to the diminution of fish in the inshore waters; that measures for the prohibition of the landing or sale of immature fish have been adopted, or are being considered, in many countries; that the artificial propagation of sea-fish is now being prosecuted with vigour by the Fishery Departments of several States; and that scientific investigations into the fisheries, by means of surveying expeditions, marine laboratories, &c., are being greatly developed and extended.

The Board is indebted to a large number of foreign fishery authorities and others for co-operation in their scientific work. Among these may be mentioned: Dr P. P. C. Hoek, the Scientific Superintendent of Dutch Fisheries; Professor Pouchet, the Director of the Concarneau Laboratory; Professor Marion, the Director of the Marine Laboratory at Marseilles; M. Raveret-Wattel, Secretary to the Société Nationale d'Acclimatation de France; Captain Dannevig, the Superintendent of the famous Sea Fish Hatchery at Flödevig, Norway; Captain Drechsel, Superintendent of Danish Fisheries, and the naturalist, Dr C. G. J. Petersen; Señor Rafael Gutierren Vela, of the Spanish Fisheries Department; Professor Giglioli, Florence; Dr A. M. Malm and Dr Rudolf Lundberg, the Inspectors of Swedish Fisheries; Mr Adolf Nielsen, the Superintendent of the Newfoundland Fisheries; Kloster-Kammer-director Herwig, the President of the Deutscher Fischerei Verein; Dr Heincke, the Director of the Biological Institute, Heligoland; Dr Ehrenbaum of Carolininsiel; Baron Jules de Guerne; and Mr Lindsay Thompson, the Chief Inspector of Fisheries, New South Wales.

The Board have also to thank Sir Thomas F. Brady, the Inspectors of Irish Fisheries, and Professor W. C. M'Intosh, F.R.S., of St Andrews, for much assistance received.

We have the honour to be,

MY LORD,

Your Lordship's most obedient Servants,

THOMAS J. BOYD, *Chairman.*
JOHN GUTHRIE SMITH, *Deputy-Chairman.*
GEORGE H. M. THOMS.
D. M'KECHNIE.
J. R. G. MAITLAND.
J. COSSAR EWART.
JAMES JOHNSTON.
WILLIAM BOYD.
W. ANDERSON SMITH.

# SECTION A.—GENERAL REPORTS.

## I.—REPORT ON THE TRAWLING EXPERIMENTS OF THE 'GARLAND,' AND ON THE STATISTICS OF THE EAST COAST FISHERIES. Part VI. (Plates I., II.)

### I. INTRODUCTORY.

During last year the trawling experiments of the 'Garland' were carried on at the various stations on the East Coast of Scotland, as in former years. The stations in the Firth of Forth and St Andrews Bay were examined once a month, so far as the weather permitted, and those in the Moray Firth and off the coasts of Forfarshire and Aberdeenshire as opportunity allowed. The number of the regular trawlings, or periodic examinations of the stations, made in the course of the year, was 156, of which 108 were in the Firth of Forth area. The detailed results of these trawling experiments are given in the tables annexed to this Report.

In addition to the systematic inquiry into the influence of beam-trawling on the fish supply, the 'Garland' was enabled to carry on throughout the year a series of experimental observations on other important fishery questions. When the weather allowed, visits were made to the fishing grounds lying off-shore, and investigations carried on as to the spawning and spawning places of the food fishes, the nature of fish-food, the distribution of the young and of the floating eggs, &c. The information thus obtained is dealt with in several papers in the present Report. The study and description of the collections of pelagic ova and larval and post-larval fishes have, as hitherto, been kindly undertaken by Professor M'Intosh, F.R.S., and have proved of unusual interest.

Continuous physical observations on the temperature and salinity of the sea have also been made at the various trawling stations and along selected lines.

As in previous years, Mr T. Scott, F.L.S., accompanied the 'Southesk,' by the courtesy of her owners, on one or two trips to the North Coast.

The statistics in connection with the trawling experiments which have been collected as to the relative amounts of fish landed by line fishermen and beam-trawlers along the East Coast, the quantities obtained by line fishermen from the territorial waters, where trawling is prohibited, the proportional amounts of small fish landed by beam-trawlers and line fishermen, &c., are discussed below. A part of the work connected with the tabulation of some of these statistics has fallen upon the fishery officers of the districts concerned, namely, Mr John Murray, Newhaven; Mr Mair, Anstruther; Mr Duff, Montrose; Mr Bain, Stonehaven; and Mr Couper, Aberdeen. The trawling returns were kept by Mr Thomas Scott, F.L.S. I have also to acknowledge the assistance of Mr W. Ramsay Smith, B.Sc., in the tabulation of the statistics, and the care and zeal with which Captain R. E. Simpson, in command of the 'Garland,' has discharged his duties.

## II. THE WORK OF THE 'GARLAND.'

### 1. The Firth of Forth.

### Plate I.

Last year the trawling stations in the Firth of Forth area were, for the first time since the experiments began, examined once in each month, 108 hauls of the trawl being made. Of these, 84 were made at the stations within the waters closed against beam-trawling and 24 at the two stations outside the closed waters. The tables containing the results of these observations will be found at page 41; and the analyses of the figures at p. 38. At the stations within the closed waters (Stations I.–VII.), the average number of fish, of all kinds, taken at each haul of the trawl, was 189·4 in 1891, compared with 228·9 in the previous year, and 164·8 in 1889. At the stations outside the closed area (Stations VIII. and IX.) the mean average number of round and flat fish captured at each haul of the net was 93, compared with 241·6 in 1890 and 111·9 in 1889. The decrease of the average catch at the stations within the closed waters last year was owing to a decrease in round fish, which fell in numbers from 121·9 in 1890 to 67·7 in 1891. There was, on the other hand, a slight increase in the numbers of flat-fish taken, the average in 1890 being 100·9, compared with 115 last year. At Stations VIII. and IX., situated in the open waters where trawling is unrestricted, there was a decrease in the average catch, both of flat-fish and round-fish. In 1890 the averages were:—flat-fish 53·7, round-fish 184·7, compared with 50·8 and 93 last year. But the great falling off at these stations was in round-fish, as these figures show.

The figures representing the mean average catch of flat-fish and round-fish per 'shot' of the trawl at the seven stations within the closed area, and at the two stations in the open area, in each year, since these experiments were begun, are given in the following tables:—

**CLOSED AREA.**

| Year. | No. of Hauls. | Average Catch per Haul. | | |
|---|---|---|---|---|
| | | Flat fish. | Round Fish. | All Fish. |
| 1886 | 22 | 112·8 | 131·8 | ... |
| 1887 | 28 | 203·1 | 144·1 | ... |
| 1888 | 40 | 117·0 | 92·1 | 211·4 |
| 1889 | 70 | 110·9 | 49·8 | 164·8 |
| 1890 | 68 | 100·9 | 121·9 | 228·9 |
| 1891 | 84 | 115·0 | 67·7 | 189·4 |

**OPEN AREA.**

| Year. | No. of Hauls. | Average Catch per Haul. | | |
|---|---|---|---|---|
| | | Flat Fish. | Round Fish. | All Fish. |
| 1886 | 5 | 47·5 | 36·7 | ... |
| 1887 | 6 | 89·8 | 123·4 | ... |
| 1888 | 10 | 34·4 | 114·7 | 151·2 |
| 1889 | 20 | 40·3 | 68·6 | 111·9 |
| 1890 | 16 | 53·7 | 184·7 | 241·6 |
| 1891 | 24 | 50·8 | 38·6 | 93·0 |

Within the closed area there was a slight increase last year in plaice, lemon dabs, common dabs, and gurnards, and a decrease in cod, haddock, whiting and turbot. At the stations in the open area there was a decrease in dabs, cod, haddock, and whiting, and a slight increase in plaice. The average number of whiting per 'shot' fell from 121·6 in 1890 to 9·0 in 1891.

Comparing the results at the different stations within the closed area, there was a general increase at Stations I. and IV., and a general decrease at all the others. Flat-fish increased at all stations except Stations II. and V. Round-fish decreased at all the stations without exception. In the open area flat-fish increased at Station IX. and decreased at Station VIII.; round-fish decreased at both.

### 2. St Andrews Bay.

During 1891 thirty-three hauls of the trawl were made at the stations in St Andrews Bay, 27 at those within the closed area and 6 outside. In the closed waters there was a considerable decrease in the general average of fish captured per 'shot,'—from 347·2 in 1890 to 133·8 in 1891. This diminution was participated in both by flat-fish and by round-fish, but to a much greater extent among the former. The average catch of flat-fish in 1890 was 302·9 per 'shot,' compared with 109·4 last year. The average of round-fish also decreased from 40 per 'shot' to 19·8. At the station in the open area the general average—including both flat-fish and round-fish—increased from 66·8 in 1890 to 300·1 in 1891, and this increase was entirely made up of flat-fish. The averages for 1890 are:—flat-fish 29·8, round-fish 35·6; and those for 1891 are—flat-fish 261·8, round-fish 30·8. The averages for each year, since the experiments were initiated, are given in the following table:—

**CLOSED AREA.**

| Year. | No. of Hauls. | Average Catch per Haul. | | |
|---|---|---|---|---|
| | | Flat Fish. | Round Fish. | All Fish. |
| 1886 | 15 | 148·7 | 27·7 | ... |
| 1887 | 16 | 346·1 | 87·6 | ... |
| 1888 | 20 | 215·6 | 68·9 | 286·0 |
| 1889 | 28 | 189·1 | 19·2 | 209·5 |
| 1890 | 24 | 302·9 | 40·0 | 347·2 |
| 1891 | 27 | 109·4 | 19·2 | 133·8 |

**OPEN AREA.**

| Year. | No. of Hauls. | Average Catch per Haul. | | |
|---|---|---|---|---|
| | | Flat Fish. | Round Fish. | All Fish. |
| 1886 | 3 | 96·6 | 73·0 | ... |
| 1887 | 4 | 133·5 | 173·2 | ... |
| 1888 | 5 | 148·8 | 72·4 | 221·2 |
| 1889 | 7 | 152·5 | 29·8 | 183·1 |
| 1890 | 6 | 29·8 | 35·6 | 66·8 |
| 1891 | 6 | 261·8 | 30·8 | 300·1 |

All kinds of flat-fish diminished in numbers within the closed waters in 1891, but the decrease was especially marked among plaice. The average per 'shot' for this fish was 207·6 in 1890, and 48·3 in 1891. Cod, whiting, and gurnards also decreased, but there was a very slight increase in haddocks. In the open area there was a very large increase in common dabs and a considerable increase in plaice and cod; while haddocks, whitings, and gurnards diminished in numbers. The decrease in flat-fish and round-fish was common to all the stations within the territorial waters.

## III. SPECIAL STATISTICS OF FISH CAUGHT BY LINE FISHERMEN AND BEAM-TRAWLERS.

### 1. Relative Quantities of Fish taken by Line and by Beam-Trawl.

A prominent feature in the statistics of the Scottish fisheries in recent years is the continuous increase in the quantities of fish landed by beam-trawlers, and a concurrent falling off in the white-fish landed by line fishermen. Table E. (p. 125) gives detailed statistics referring to this subject for certain important districts on the East Coast, and Table I. (p. 159) shows the relative quantities landed monthly along the whole East Coast by beam-trawlers and by line fishermen.

The five districts from which special returns have been obtained (p. 125) comprise that portion of the East Coast between Dunbar on the south and Aberdeen on the north, including both these places. The quantity of fish landed on this portion of the coast last year by line fishermen and beam-trawlers was 759,440 cwts., compared with 739,071 cwts. in 1890, or an increase of 20,369 cwts. This increase was principally in round-fish, but there was also a slight increase in flat-fish. In 1890 the quantity of flat-fish was 100,389 cwts., against 101,935 cwts. last year, showing an increase in 1891 of 1546 cwts. The quantity of round-fish in 1890 was 638,682 cwts., against 657,505 cwts. in 1891, or an increase of 18,823 cwts. in the latter year.

The increase in the quantity of white-fish landed in these districts during 1891 was entirely due to the operations of beam-trawlers, a large falling off in the quantities landed by line fishermen having taken place. In 1890, line fishermen landed 28,170 cwts. of flat-fish and 430,070 cwts. of round-fish, or a total of 458,227 cwts. Last year they landed 25,587¾ cwts. of flat-fish and 418,281 cwts. of round-fish, or a total quantity of 443,868¾ cwts. These figures indicate a total decrease in line-caught fish of 14,358 cwts.; the decrease in flat-fish being 2582 cwts. and in round-fish 11,776 cwts.

On the other hand, the quantity of fish landed by beam-trawlers increased by 34,728 cwts.; the gross quantity in 1890 being 280,844 cwts., compared with 315,571¾ last year. In 1891, beam-trawlers landed 76,347¼ cwts. of flat-fish and 239,224½ cwts. of round-fish, as against 72,219 cwts. of flat-fish and 208,625 cwts. of round-fish in 1890, showing an increase last year of 4128 cwts. of flat-fish and 30,599 cwts. of round-fish.

The relative quantities of all white-fish landed by beam-trawlers and line fishermen in the districts referred to during the last three years are as follows:—

| Year. | Line Boats. | | | Beam-Trawlers. | | |
|---|---|---|---|---|---|---|
| | Flat Fish. | Round Fish. | Total. | Flat Fish. | Round Fish. | Total. |
| | cwts. | cwts. | cwts. | cwts. | cwts. | cwts. |
| 1889 | 23,035 | 453,554 | 476,589 | 60,117 | 155,601 | 215,718 |
| 1890 | 28,170 | 430,057 | 458,227 | 72,219 | 208,625 | 280,844 |
| 1891 | 25,587 | 418,281 | 443,868 | 76,347 | 239,224 | 315,571 |

These figures, which include skates and all kinds of fish, show that at this part of the Coast, where trawl-caught fish are chiefly landed, the quantity of white-fish brought ashore by beam-trawlers has increased during the last three years by almost exactly 100,000 cwts. or 5,000 tons, while the white-fish landed by line fishermen has diminished in quantity by over 32,000 cwts.

Comparing the returns from the various districts during the two years, it is found that line fishermen in 1891 landed smaller quantities of white-fish in the Leith, Stonehaven, and Aberdeen districts; in the Anstruther district the totals are about the same, but in the Montrose district the figures indicate an increase. The decrease in the Aberdeen district was very slight; it was greatest in the Leith district. The figures for each district are given in the following table:—

| Districts. | 1890. | | | 1891. | | |
|---|---|---|---|---|---|---|
| | Flat Fish. | Round Fish. | Total. | Flat Fish. | Round Fish. | Total. |
| *Leith District.* | cwts. | cwts. | cwts. | cwts. | cwts. | cwts. |
| 1. Line boats, . . . . | 6,297 | 103,307 | 109,604 | 7,167 | 86,799½ | 93,966½ |
| 2. Beam-trawlers, . . . | 15,399 | 74,091 | 89,490 | 14,762 | 81,190½ | 95,952½ |
| *Anstruther District.* | | | | | | |
| 1. Line boats, . . . . | 6,506 | 72,275 | 78,781 | 5,017 | 73,885 | 78,902 |
| *Montrose District.* | | | | | | |
| 1. Line boats, . . . . | 2,753 | 101,389 | 104,142 | 3,925¼ | 103,842½ | 107,767¾ |
| 2. Beam-trawlers, . . . | 6,389 | 12,792 | 19,181 | 5,295¼ | 15,140 | 20,435¼ |
| *Stonehaven District.* | | | | | | |
| 1. Line boats, . . . . | 1,046 | 47,070 | 48,116 | 726 | 45,471 | 46,197 |
| *Aberdeen District.* | | | | | | |
| 1. Line boats, . . . . | 11,568 | 106,016 | 117,584 | 8,752½ | 108,283 | 117,035½ |
| 2. Beam-trawlers, . . . | 50,431 | 121,742 | 172,173 | 56,290 | 142,894 | 199,184 |
| *Totals.* | | | | | | |
| 1. Line boats, . . . . | 28,170 | 430,057 | 458,227 | 25,587¾ | 418,281 | 443,868¾ |
| 2. Beam-trawlers, . . . | 72,219 | 208,625 | 280,844 | 76,347¼ | 239,224½ | 315,571¾ |

In Table I. are given the quantities of round-fish and flat-fish landed last year by line fishermen and beam-trawlers along the whole East Coast

of Scotland. It shows, as in previous years, that the quantity landed by beam-trawlers has increased, and the quantity landed by line fishermen has diminished. The total quantity of flat-fish and round-fish landed along the East Coast last year was 1,313,811 cwts.; in 1890, the quantity was 1,337,470, showing that there was a decrease of 23,659 cwts. in these kinds of fish. The quantity landed by line-fishermen was 1,009,911 cwts., as against 1,051,852½ cwts. in 1890. Beam-trawlers landed 303,900½ cwts. of round-fish and flat-fish, or an increase of 18,284 cwts. The decrease in the amount of line-fish landed was both in flat-fish and round-fish: in the same way the increase in the quantity landed by beam-trawlers was both in round-fish and flat-fish. Similar returns for the past four years show that beam-trawlers have been landing larger and larger quantities of these kinds of fish, while the quantities landed by line-fishermen have diminished. The figures are as follows:—

| Year. | Round Fish. | | Flat Fish. | |
|---|---|---|---|---|
| | Line. | Beam-Trawl. | Line. | Beam-Trawl. |
| | cwts. | cwts. | cwts. | cwts. |
| 1888 | 1,029,961 | 179,074 | 60,752¼ | 64,723¾ |
| 1889 | 1,057,450 | 166,818 | 53,870¾ | 60,595¾ |
| 1890 | 993,180½ | 212,475½ | 58,673 | 73,141 |
| 1891 | 957,609 | 227,894½ | 52,302¼ | 76,006 |

## 2. Statistics Showing the Quantities of Line-Caught Fish obtained from the Territorial Waters where Trawling is Prohibited.

The statistics of the quantities of fish captured by line-fishermen in the territorial waters of the East Coast, from North Berwick on the south to Skateraw, a few miles south of Aberdeen, on the north, are given in Tables G (p. 140). The monthly and yearly averages per 'shot' for each kind of fish enumerated are also given. The quantities of white-fish caught within the territorial waters of the portion of the Coast referred to, in each of the years 1889, 1890, and 1891, are given in Table H. (p. 158). During last year there was an increase in the number of 'shots' in this portion of the territorial waters and in the quantity of fish landed, compared with the previous year.

In 1890 the number of 'shots' was 34,501, and the quantity of white-fish (excluding herrings) captured was 83,692¼ cwts., giving an average of 2·425 cwts. per 'shot.' In 1891 the number of 'shots' was 37,928, and the quantity of line-caught fish was 92,469 cwts., or an average per 'shot' of 2·438 cwts.

The statistics showing the number of 'shots' in the territorial waters, the quantity of line-caught fish obtained, and the average quantity per 'shot' for the past four years, are as follows:—

| Year. | Total Trips or Shots. | Quantity of White Fish caught. | Average Quantity per Shot. |
|---|---|---|---|
| | | cwts. | cwts. |
| 1888 | 43,077 | 109,396¼ | 2·539 |
| 1889 | 42,898 | 107,029¼ | 2·494 |
| 1890 | 34,501 | 83,692¼ | 2·425 |
| 1891 | 37,928 | 92,469 | 2·438 |

In regard to the kinds of fish, there was an increase in 1891 in cod, haddock, and other white fish, and a slight decrease in flat-fish and whiting. In all the districts an increase occurred, except in the Anstruther district where the decrease was slight. In the Leith district there was an increased catch of cod, haddock, whiting, and of 'other white fish,' and a decrease in flat-fish. In the Anstruther district there was also a decrease in flat-fish, and an increase in cod and haddock. In the Montrose district there was an increase in all except whiting. In the Stonehaven district there was a decrease in flat-fish and whiting, and an increase in all the others. The quantity of flat-fish (lemon soles, flounders, dabs, turbot, and skate) caught by line fishermen within the territorial waters of the Leith and Anstruther districts (the Firth of Forth and St Andrews Bay) last year was 5131½ cwts., compared with 6799½ cwts. in 1890, or a decrease of 1668 cwts. The gross quantities of flat-fish captured, and the average per 'shot,' within the territorial waters of these two districts during the last four years, are as follows:—

| 1888 | | 1889 | | 1890 | | 1891 | |
|---|---|---|---|---|---|---|---|
| Cwts. | Average | Cwts. | Average | Cwts. | Average | Cwts. | Average |
| 7359¼ | 0·288 | 5677 | 0·221 | 6799½ | 0·344 | 5131½ | 0·241 |

Mr William Mair, the Fishery Officer of the Anstruther district, has furnished the following table showing the quantities of haddocks and whitings caught within and without the territorial waters of his district (Firth of Forth and St Andrews Bay) in each year since 1888.

| Year. | Caught within the Closed Area. | | Caught outside the Closed Area. | | Total. | |
|---|---|---|---|---|---|---|
| | Haddocks. | Whitings. | Haddocks. | Whitings. | Haddocks. | Whitings. |
| | cwts. | cwts. | cwts. | cwts. | cwts. | cwts. |
| 1888 | 18,419 | 1,800 | 17,862 | 1,131 | 36,281 | 2,931 |
| 1889 | 12,499 | 1,972 | 19,405 | 1,645 | 31,904 | 3,617 |
| 1890 | 12,418 | 1,994 | 10,338 | 1,595 | 22,756 | 3,589 |
| 1891 | 11,981 | 1,577 | 11,255 | 1,244 | 23,236 | 2,821 |

### 3. Buckhaven Haddock and Cod Line Fishing.

Table D (p. 124) gives detailed statistics of the Buckhaven inshore line fishing for the years 1890 and 1891.* The falling off in the number of 'shots,' or visits to the fishing grounds, which has been going on since 1887, is again noticeable in the table for last year. In 1890, the Buckhaven fishermen made 3396 'shots' at this fishing, compared with 3296 in 1891. In 1886 the number of shots was 7869, or 4573 more than last year. As might be anticipated from the great decrease in the number of boats fishing, the quantity of fish caught per 'shot' of the lines has increased. Last year the average number of cod caught per 'shot' was 0·91, compared with 0·72 in 1890. There was also an increased average catch of large haddocks,—from 78·8 in 1890 to 103·8

* These special returns for this important fishing Station have been collected by Mr William Mair, the fishery officer of the district.

last year; but there was a decrease in the quantities of small haddocks and whitings, namely, from 130·5 to 92·8. The figures for the last eight years are as follows:—

| Year. | Total Number of 'Shots' during the Year. | Average Number of Cod per 'Shot.' | Average Number of Large Haddocks per 'Shot.' | Average Number of Small Haddocks and Whitings per 'Shot.' |
|---|---|---|---|---|
| 1884* | 4524 | 0·34 | 22·1 | 38·3 |
| 1885 | 4542 | 0·50 | 23·4 | 221·5 |
| 1886 | 7869 | 0·32 | 31·8 | 147·0 |
| 1887 | 6270 | 0·23 | 42·8 | 208·9 |
| 1888 | 5548 | 0·45 | 62·6 | 228·4 |
| 1889 | 4535 | 0·46 | 80·1 | 68·4 |
| 1890 | 3396 | 0·72 | 78·8 | 130·5 |
| 1891 | 3296 | 0·91 | 103·8 | 92·8 |

As in previous years the largest proportions of cod were taken in December and January, and of small haddocks and whitings during the summer months.

### 4. The Proportion of Large and Small Fish captured by Beam-Trawlers and Line Fishermen.

In Table F (p. 136) are given the relative quantities of large and small white fish captured by beam-trawlers and line fishermen and landed in the Leith and Aberdeen districts. In the Leith district, beam-trawlers landed 16,099 cwts. of large cod and 1613 cwts. of small, as against 31,941 cwts. large and 3341 cwts. small landed by line fishermen. Beam-trawlers landed 39,922 cwts. of large haddocks and whitings, and 9258 cwts. of small haddocks and whitings; while the quantities landed by line fishermen were 31,902 cwts. large and 5211 cwts. small. Beam-trawlers landed 9152 cwts. of large flat-fish and 895 cwts. small, compared with 2910 cwts. of large and 752 cwts. small landed by line fishermen.

In the Aberdeen district beam-trawlers landed 13,622 cwts. of large cod and 6921 cwts. of small, while line fishermen landed 30,137 cwts. of large and 3120 cwts. of small. The quantity of large haddocks and whitings landed by beam-trawlers was 72,648 cwts., and of small 30,004 cwts.; line fishermen landed 38,657 cwts. large and 26,206 small. The quantity of large flat-fish landed by beam-trawlers was 48,260½ cwts. and of small 1062¼ cwts., while line fishermen landed only 3½ cwts. of large flat-fish and 309 cwts. of small. It will be noticed that the returns from the two districts named vary considerably, and since the figures are based largely upon estimate there is a wide margin for error.

### Summary.

From what has been said above it is evident that the trawling experiments of the 'Garland' show that a considerable decrease occurred last year in the abundance of the food-fishes within the closed waters of the Firth of Forth and St Andrews Bay. This diminution was chiefly in

* For the nine months only, from April to December.

round-fish, but very considerably also in flat-fish in St Andrews Bay. There was a slight increase in flat-fish in the Firth of Forth. It is to be expected that from year to year considerable fluctuations should occur in the abundance of round-fish, such as cod, haddock, and whiting. These fish are believed to be more migratory in their habits than flat-fish; they live to a considerable extent upon other fish, and upon herring spawn; and hence, when shoals of herrings or sprats frequent the territorial waters in greater numbers in one season than in another, these round-fish are also usually found in greater abundance. With flat-fish it is somewhat different. They do not appear to migrate to any distance in pursuit of food; but, at the spawning season—that is, for a limited period during the year—the large mature individuals of the more important kinds seem to move out beyond the territorial waters on the East Coast to cast their spawn. From the more local habits of flat-fishes, it might naturally be expected that the prohibition of beam-trawling—the mode of fishing by which they are chiefly captured—for a term of years, in a large area like the Firth of Forth and St Andrews Bay, would be followed by a gradual and considerable increase in their numbers. The trawling experiments of the 'Garland,' and the statistics previously referred to, do not show that such an increase has occurred.

These experiments were begun in 1886 in the Firth of Forth and St Andrews Bay, and although the results obtained during the comparatively short period of six years cannot be regarded as conclusive, they afford the means of comparison between the first three years and the last three years following the prohibition of trawling. The mean annual averages per 'shot' of the trawl in the closed waters of the Firth of Forth and St Andrews Bay, and in the open waters where trawling is not prohibited, are as follows:—

| Year. | Closed Area. | | | Open Area. | | |
|---|---|---|---|---|---|---|
| | Flat Fish. | Round Fish. | Total. | Flat Fish. | Round Fish. | Total. |
| 1886 | 130·8 | 79·7 | 210·5 | 72·0 | 54·8 | 126·6 |
| 1887 | 274·6 | 115·8 | 390·4 | 111·6 | 148·3 | 259·9 |
| 1888 | 166·3 | 248·7 | 415·0 | 91·6 | 188·2 | 279·8 |
| 1889 | 150·0 | 187·1 | 337·1 | 96·4 | 147·5 | 243·9 |
| 1890 | 201·9 | 234·5 | 436·4 | 41·7 | 154·2 | 195·9 |
| 1891 | 112·2 | 43·4 | 155·6 | 156·3 | 34·7 | 191·0 |

It is clear from the above analysis of the results of the trawling experiments since 1886 that the prohibition of beam-trawling within the Firth of Forth and St Andrews Bay has not been followed by the increase in the abundance of flat-fishes within these waters which was anticipated. The averages per 'shot' for the first and last three years are as follows:—

| Year. | Closed Area. | | | Open Area. | | |
|---|---|---|---|---|---|---|
| | Flat Fish. | Round Fish. | Total. | Flat Fish. | Round Fish. | Total. |
| 1886–1888 | 190·6 | 148·1 | 338·6 | 91·7 | 130·4 | 222·2 |
| 1889–1891 | 154·7 | 155·0 | 309·7 | 98·1 | 112·1 | 210·2 |

These figures indicate that within the closed area flat-fish have, on the whole, diminished rather than increased; but in considering this fact it is necessary to bear in mind, on the one hand, the results of certain concurrent investigations carried out on board the 'Garland,' and, on the other hand, the greatly increased development of beam-trawling in recent years. It has been shown by the researches of the 'Garland' that the great majority of the food fishes—cod, haddock, whiting, plaice, lemon soles, &c.—either do not spawn at all within the closed area referred to, or only to a slight extent in the case of some forms. The adult fish, when mature, leave the territorial waters and congregate at the spawning time beyond the three-mile limit, where the eggs are cast forth in myriads and are gradually floated in vast numbers towards the shallow water. It is among these off-shore spawning shoals that trawlers work on a large scale, and it is obvious that if the adult fish are captured on the breeding grounds in greatly increased numbers before they have spawned the supply of young fishes for the in-shore waters must be materially reduced. It may be said, as the results of four years continuous investigations, that none, or scarcely any, of the plaice, lemon soles, cod, haddock, or turbot to be found within the waters of the Firth of Forth or St Andrews Bay were born there. They have been floated in at an early stage of their existence, or have migrated thither at a later period. It has been also shown by the investigations made on board the 'Garland' that, while immature fish of certain kinds are most abundant within the three-mile limit, the majority are to be found without that limit, up to a distance of ten or twelve miles from shore.

Whatever be the cause, there can be little doubt that the abundance of fish in the territorial waters of this part of the coast is not increasing.

T. WEMYSS FULTON,
*Secretary for Scientific Investigation.*

TABLE A.—Showing Summary of Fish taken by the 'Garland' in Trawling Operations in 1891.

| Station and Date. | Flat-Fish. | | | | | | | | | Round-Fish. | | | | | Skate. | Other Fish. | Total. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Plaice. | Lemon Sole. | Witch Sole. | Common Dabs. | Long Roughs. | Flounder. | Turbot. | Brill. | Total. | Cod. | Haddock. | Whiting. | Gurnard. | Total. | | | |
| **Firth of Forth—** | | | | | | | | | | | | | | | | | |
| **Station I.** | | | | | | | | | | | | | | | | | |
| Jan. 15, | 1 | 4 | . | 18 | 24 | . | . | . | 42 | 144 | . | 154 | . | 298 | 6 | 10 | 356 |
| Feb. 23, | 4 | 11 | . | 42 | 19 | . | . | . | 76 | 20 | . | 8 | . | 28 | 1 | 1 | 106 |
| Mar. 12, | 8 | 14 | . | 21 | 9 | 3 | . | . | 55 | 37 | 1 | 18 | . | 56 | 12 | 13 | 136 |
| April 15, | 8 | 22 | . | 31 | 21 | 2 | . | . | 84 | 31 | 3 | 21 | . | 55 | 5 | 17 | 161 |
| May 23, | 31 | 13 | . | 32 | 13 | . | . | . | 89 | 9 | . | . | 40 | 49 | 1 | 15 | 154 |
| June 22, | 87 | 52 | . | 124 | 32 | . | . | . | 295 | 21 | 45 | 30 | 66 | 162 | 1 | 3 | 461 |
| July 15, | 52 | 73 | . | 57 | 14 | . | . | . | 196 | 40 | 12 | 1 | 1 | 54 | . | 5 | 255 |
| Aug. 14, | 12 | 53 | . | 9 | 17 | . | . | . | 91 | 17 | 1 | 8 | 13 | 39 | . | 4 | 134 |
| Sept. 19, | 35 | 23 | . | 29 | 31 | . | . | . | 118 | 9 | 2 | 20 | 8 | 39 | 1 | 1 | 159 |
| Oct. 24, | 20 | 54 | . | 51 | 46 | . | . | . | 171 | 8 | . | 88 | 9 | 105 | 1 | 5 | 282 |
| Nov. 25, | 6 | 19 | . | 37 | 7 | . | . | . | 69 | 12 | . | 31 | . | 43 | 2 | 3 | 117 |
| Dec. 17, | 14 | 32 | . | 36 | 45 | . | . | . | 127 | 6 | 15 | 42 | 1 | 64 | 4 | 7 | 202 |
| | 278 | 370 | . | 482 | 278 | 5 | . | . | 1418 | 354 | 79 | 421 | 138 | 992 | 34 | 84 | 2528 |
| **Station II.** | | | | | | | | | | | | | | | | | |
| Jan. 15, | 2 | 1 | . | 4 | 18 | . | . | . | 25 | 52 | 1 | 35 | . | 88 | 6 | 1 | 120 |
| Feb. 24, | 37 | 2 | . | 17 | 5 | . | . | . | 61 | 1 | . | . | . | 1 | 3 | 7 | 72 |
| Mar. 13, | 41 | 6 | . | 22 | 4 | 11 | . | . | 84 | 6 | . | . | 1 | 7 | . | 2 | 93 |
| April 15, | 17 | 5 | . | 17 | 4 | 3 | . | . | 46 | 11 | . | 1 | 1 | 13 | . | 3 | 62 |
| May 25, | 91 | 10 | . | 27 | 21 | . | . | . | 149 | 1 | 8 | 2 | 26 | 37 | 1 | 7 | 194 |
| June 22, | 80 | 14 | . | 118 | 11 | . | . | . | 223 | 2 | 37 | 11 | 40 | 90 | 1 | 2 | 316 |
| July 15, | 112 | 14 | . | 71 | 16 | . | . | . | 213 | 4 | 2 | 6 | 14 | 26 | 1 | . | 240 |
| Aug. 14, | 95 | 30 | . | 124 | 3 | . | . | . | 252 | 18 | 28 | 4 | 4 | 54 | 5 | 1 | 312 |
| Sept. 19, | 70 | 5 | . | 75 | 12 | . | . | . | 162 | 2 | 24 | 10 | 14 | 50 | . | . | 212 |
| Oct. 23, | 77 | 2 | . | 156 | 42 | . | . | . | 277 | . | 13 | 76 | 4 | 93 | 1 | 1 | 372 |
| Nov. 21, | 16 | 1 | . | 94 | 44 | . | . | . | 155 | 1 | 17 | 24 | 8 | 50 | . | 3 | 208 |
| Dec. 17, | 16 | . | . | 13 | 21 | . | . | . | 50 | 1 | 59 | 40 | . | 100 | 2 | 1 | 153 |
| | 654 | 90 | . | 738 | 201 | 14 | . | . | 1697 | 99 | 189 | 209 | 112 | 609 | 20 | 28 | 2354 |
| **Station III.** | | | | | | | | | | | | | | | | | |
| Jan. 19, | . | 4 | . | 7 | 34 | 1 | . | . | 46 | 129 | . | 85 | . | 214 | . | 7 | 267 |
| Feb. 18, | 6 | 7 | . | 38 | 21 | . | . | . | 72 | 22 | . | 2 | . | 24 | 2 | 8 | 106 |
| Mar. 14, | 17 | 26 | . | 12 | 4 | . | . | . | 59 | 37 | . | 54 | . | 91 | 3 | 5 | 158 |
| May 4, | 20 | 27 | . | 26 | 20 | 3 | . | . | 96 | 35 | 1 | 44 | 33 | 113 | 2 | 6 | 217 |
| May 27, | 57 | 51 | . | 26 | 18 | 1 | . | . | 153 | 22 | 1 | 8 | 65 | 96 | 2 | 6 | 257 |
| June 20, | 86 | 47 | . | 89 | 17 | . | . | . | 189 | 18 | 1 | 18 | 17 | 54 | . | 4 | 247 |
| July 18. | 28 | 47 | . | 41 | 35 | 1 | . | . | 152 | 8 | 1 | 33 | 5 | 47 | 1 | 4 | 204 |
| Aug. 17, | 2 | . | . | 2 | 1 | . | . | . | 5 | 1 | . | 8 | 2 | 11 | . | 1 | 17 |
| Sept. 23, | 11 | 35 | . | 23 | 6 | . | . | . | 75 | 20 | . | 21 | 4 | 45 | 4 | 8 | 132 |
| Oct. 19, | 11 | 35 | . | 85 | 23 | . | . | . | 154 | 17 | 3 | 200 | 31 | 251 | 3 | 6 | 414 |
| Nov. 20, | - | 14 | . | 68 | 53 | . | . | . | 135 | 6 | 31 | 135 | 3 | 175 | 10 | 6 | 326 |
| Dec. 24, | - | 6 | . | 32 | 21 | . | . | . | 59 | 6 | 22 | 45 | 2 | 75 | 3 | 5 | 142 |
| | 188 | 299 | . | 449 | 253 | 6 | . | . | 1196 | 321 | 60 | 653 | 162 | 1196 | 30 | 66 | 2487 |

TABLE A.—SHOWING SUMMARY OF FISH TAKEN BY THE 'GARLAND' IN TRAWLING OPERATIONS IN 1891—*continued.*

| Station and Date. | Flat-Fish. Plaice. | Lemon Sole. | Witch Sole. | Common Dabs. | Long Roughs. | Flounder. | Turbot. | Brill. | Total. | Round-Fish. Cod. | Haddock. | Whiting. | Gurnard. | Total. | Skate. | Other Fish. | Total. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FIRTH OF FORTH—*continued.* | | | | | | | | | | | | | | | | | |
| **Station IV.** | | | | | | | | | | | | | | | | | |
| Jan. 24, . | 97 | . | . | 2 | 1 | . | . | . | 100 | 4 | . | . | . | 4 | 1 | . | 105 |
| Feb. 17, . | 151 | 1 | . | 2 | . | 2 | . | . | 156 | . | . | . | . | . | . | . | 156 |
| Mar. 18, . | 139 | 6 | . | 28 | 3 | . | . | . | 176 | 26 | . | 1 | . | 27 | 2 | . | 205 |
| May 4, . | 137 | 3 | . | 14 | 4 | . | . | . | 158 | 1 | . | . | 63 | 64 | 14 | 5 | 241 |
| May 26, . | 182 | 10 | . | 44 | 5 | 1 | . | . | 242 | 7 | . | . | 71 | 78 | 8 | 12 | 340 |
| June 18, . | 301 | 8 | . | 47 | 4 | . | . | . | 360 | 14 | . | 3 | 9 | 26 | 9 | 3 | 398 |
| July 17, . | 177 | 32 | . | 41 | 6 | . | . | . | 256 | 14 | . | 1 | 26 | 41 | 10 | 9 | 316 |
| Aug. 15, . | 117 | 6 | . | 9 | . | . | . | . | 132 | 2 | . | 3 | 28 | 33 | 3 | 1 | 169 |
| Sept. 18, . | 154 | 4 | . | 11 | 1 | . | . | . | 170 | 11 | . | 14 | 43 | 68 | 4 | 3 | 245 |
| Oct. 16, . | 16 | . | . | 3 | 2 | . | . | . | 21 | . | . | 23 | 1 | 24 | . | *48 | 93 |
| Nov. 20, . | 198 | . | . | 68 | 3 | . | . | 1 | 270 | 4 | . | 13 | 1 | 18 | . | *9 | 297 |
| Dec. 18, . | 28 | 15 | . | 135 | 48 | . | . | . | 226 | 19 | 1 | 150 | . | 170 | . | 6 | 402 |
| | 1697 | 85 | . | 404 | 77 | 3 | . | 1 | 2267 | 102 | 1 | 208 | 242 | 553 | 51 | 96 | 2967 |
| **Station V.** | | | | | | | | | | | | | | | | | |
| Jan. 21, . | 1 | 4 | 4 | 8 | 56 | . | . | 1 | 74 | 26 | 13 | 35 | 1 | 75 | 1 | 3 | 153 |
| Feb. 20, . | 9 | 6 | 1 | 22 | 57 | . | . | . | 95 | 47 | 6 | 22 | . | 75 | . | 9 | 179 |
| Mar. 19, . | 21 | 6 | 6 | 7 | 41 | . | . | . | 81 | 40 | 21 | 31 | 1 | 93 | 2 | 7 | 183 |
| May 6, . | 23 | 35 | 8 | 17 | 27 | 1 | . | . | 106 | 17 | 15 | 14 | 19 | 65 | 1 | 3 | 175 |
| May 28, . | 25 | 12 | 7 | 12 | 46 | . | . | . | 102 | 16 | 18 | 7 | 38 | 79 | . | 3 | 184 |
| June 19, . | 21 | 12 | 2 | 7 | 43 | . | . | . | 85 | 10 | 93 | 19 | 49 | 171 | 4 | 3 | 263 |
| July 17, . | 34 | 13 | 1 | 7 | 40 | . | . | . | 95 | 15 | 122 | 12 | 35 | 184 | . | . | 279 |
| Aug. 18, . | 25 | . | 1 | 3 | 20 | . | . | . | 49 | 4 | 28 | 5 | 39 | 76 | . | 4 | 129 |
| Oct. 1, . | 1 | 2 | . | 4 | 16 | . | . | . | 23 | 2 | 5 | 28 | 1 | 36 | 1 | . | 60 |
| Oct. 22, . | 18 | 3 | 1 | 11 | 88 | . | . | . | 121 | 11 | 21 | 51 | 5 | 88 | 1 | 2 | 212 |
| Nov. 24, . | 6 | . | . | 31 | 67 | . | . | . | 104 | 1 | 1 | 4 | . | 6 | . | 3 | 113 |
| Dec. 23, . | 5 | . | . | 8 | 25 | . | . | . | 38 | 1 | 3 | 6 | . | 10 | 1 | 4 | 53 |
| | 189 | 93 | 26 | 137 | 526 | 1 | . | 1 | 973 | 190 | 346 | 234 | 188 | 958 | 11 | 41 | 1983 |
| **Station VI.** | | | | | | | | | | | | | | | | | |
| Jan. 21, . | 11 | 11 | . | 8 | 2 | . | . | . | 32 | 7 | 1 | 3 | . | 11 | . | 1 | 44 |
| Feb. 20, . | 5 | 7 | . | 7 | 5 | . | . | . | 24 | 2 | . | . | . | 2 | . | . | 26 |
| Mar. 21, . | 70 | 18 | . | 21 | 1 | 3 | . | 1 | 114 | 25 | 1 | 2 | 1 | 29 | . | 4 | 147 |
| May 6, . | 6 | 3 | . | 4 | 2 | . | . | . | 15 | 4 | . | 4 | 2 | 10 | . | . | 25 |
| May 28, . | 26 | 7 | . | 16 | . | . | . | . | 49 | 6 | . | 1 | 9 | 16 | . | 3 | 68 |
| June 24, . | 11 | 3 | . | 6 | . | . | 1 | . | 21 | 3 | . | 20 | 58 | 81 | . | 1 | 103 |
| July 15, . | 12 | 15 | . | 10 | . | . | . | 1 | 38 | . | 5 | 4 | 31 | 40 | . | 10 | 88 |
| Aug. 19, . | 23 | 12 | . | 10 | . | . | . | . | 45 | 4 | . | 1 | 9 | 14 | . | 12 | 71 |
| Oct. 3, . | 60 | 29 | . | 24 | . | . | . | . | 113 | 11 | 4 | 26 | 24 | 65 | . | 1 | 179 |
| Oct. 22, . | 92 | 7 | . | 27 | . | . | . | 2 | 128 | 3 | . | 2 | 6 | 11 | . | . | 139 |
| Nov. 25, . | 88 | 8 | . | 50 | . | . | . | 3 | 149 | 2 | . | 1 | 3 | 6 | . | 2 | 157 |
| Dec. 23, . | 54 | 7 | . | 30 | 4 | . | 1 | 3 | 99 | . | 1 | . | 2 | 3 | . | 2 | 104 |
| | 458 | 127 | . | 213 | 14 | 3 | 2 | 10 | 827 | 67 | 12 | 64 | 145 | 288 | . | 36 | 1151 |
| **Station VII.** | | | | | | | | | | | | | | | | | |
| Jan. 12, . | 6 | 1 | . | 2 | 15 | . | . | . | 24 | 15 | . | 40 | . | 55 | 3 | 1 | 83 |
| Feb. 20, . | 8 | . | 1 | 22 | 9 | . | . | . | 40 | 1 | 2 | 6 | . | 9 | . | 4 | 53 |
| Mar. 19, . | 4 | 2 | 1 | 14 | 2 | 4 | . | . | 27 | 6 | 11 | 16 | . | 33 | 9 | . | 69 |
| May 5, . | 29 | 5 | . | 24 | 8 | 2 | . | . | 68 | 2 | 3 | 3 | 65 | 73 | 2 | 4 | 147 |
| May 27, . | 24 | 17 | . | 78 | 16 | . | . | . | 135 | . | 10 | 3 | 84 | 97 | . | 5 | 237 |
| June 23, . | 32 | 8 | 2 | 57 | 35 | 4 | . | . | 138 | 2 | 123 | 6 | 40 | 171 | 3 | 2 | 314 |
| July 16, . | 41 | 10 | . | 102 | 61 | . | . | . | 214 | 1 | 150 | 13 | 16 | 180 | 2 | 3 | 399 |
| Aug. 17, . | 24 | 3 | . | 172 | 42 | . | . | . | 241 | 1 | 55 | 7 | 10 | 73 | 2 | 2 | 318 |
| Sept. 23, . | 13 | 4 | . | 44 | 11 | . | . | . | 72 | 11 | 67 | 79 | 29 | 186 | 4 | 4 | 266 |
| Oct. 21, . | 10 | . | 1 | 222 | 74 | . | 1 | . | 308 | 1 | 11 | 120 | 36 | 168 | 1 | 1 | 478 |
| Nov. 24, . | 5 | 3 | . | 7 | 10 | . | . | . | 25 | . | 29 | 17 | . | 46 | . | 1 | 72 |
| Dec. 21, . | . | . | . | . | . | . | . | . | . | 1 | . | 7 | . | 8 | . | 1 | 9 |
| | 196 | 53 | 5 | 744 | 283 | 10 | 1 | . | 1292 | 41 | 461 | 317 | 280 | 1099 | 26 | 28 | 2445 |

* Sprats.

**TABLE A.—Showing Summary of Fish taken by the 'Garland' in Trawling Operations in 1891—*continued.***

| Station and Date. | Flat-Fish. | | | | | | | | | Round-Fish. | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Plaice. | Lemon Sole. | Witch Sole. | Common Dabs. | Long Roughs. | Flounder. | Turbot. | Brill. | Total. | Cod. | Haddock. | Whiting. | Gurnard. | Total. | Skate. | Other Fish. | Total. |
| **Firth of Forth**—*continued.* | | | | | | | | | | | | | | | | | |
| **Station VIII.** | | | | | | | | | | | | | | | | | |
| Jan. 29, | 2 | . | . | 4 | 17 | . | . | . | 23 | 4 | 5 | 24 | . | 33 | 1 | 2 | 59 |
| Feb. 19, | . | . | . | 13 | 37 | . | . | . | 50 | 2 | 11 | 10 | . | 23 | 1 | 1 | 75 |
| Mar. | No | tra | wlin | g | . | . | . | . | . | . | . | . | . | . | . | . | . |
| April 14, | 2 | 3 | 1 | 20 | 9 | . | 1 | . | 36 | 7 | 9 | 34 | 24 | 74 | 1 | 5 | 116 |
| May 29, | . | 1 | 8 | 21 | 30 | . | . | . | 60 | 1 | 6 | 2 | 39 | 48 | 8 | . | 116 |
| June 24, | 2 | 9 | 1 | 16 | 34 | . | . | . | 62 | 3 | 78 | . | 69 | 150 | . | 2 | 214 |
| July 21, | 12 | 1 | 4 | 28 | 23 | . | . | . | 68 | 3 | 44 | 6 | 64 | 117 | 4 | 2 | 191 |
| Aug. 18, | 8 | . | 1 | 9 | 22 | 1 | . | . | 41 | 1 | 20 | 12 | 10 | 48 | . | . | 84 |
| Sept. 24, | 1 | . | . | 15 | 32 | . | . | . | 48 | 4 | 7 | 14 | . | 25 | . | . | 73 |
| Oct. 30, | 8 | . | 1 | 32 | 73 | . | . | . | 114 | . | 5 | 3 | 12 | 20 | 5 | 1 | 140 |
| Nov. 23, | 2 | . | . | 4 | 5 | . | . | . | 11 | . | 4 | 7 | . | 11 | 1 | . | 23 |
| Dec. 21, | 1 | 1 | . | 2 | . | . | . | . | 4 | 1 | 1 | . | . | 2 | . | . | 6 |
| | 38 | 15 | 16 | 164 | 282 | 1 | 1 | . | 517 | 26 | 190 | 112 | 218 | 546 | 21 | 13 | 1097 |
| **Station IX.** | | | | | | | | | | | | | | | | | |
| Jan. 29, | . | 1 | 1 | . | 16 | . | . | . | 18 | 5 | 6 | 28 | . | 39 | 1 | 11 | 69 |
| Feb. 19, | 1 | 1 | . | 22 | 10 | . | . | . | 34 | 1 | 3 | 6 | 1 | 11 | 1 | 1 | 47 |
| Mar. | No | tra | wlin | g | . | . | . | . | . | . | . | . | . | . | . | . | . |
| April 14, | 3 | 3 | 3 | 2 | 7 | . | . | . | 18 | 4 | 6 | 22 | 5 | 37 | 1 | 10 | 66 |
| May 29, | 2 | 3 | 1 | 14 | 22 | . | 1 | . | 43 | . | 11 | 11 | 10 | 32 | 1 | 4 | 80 |
| June 24, | 1 | . | . | 2 | 11 | . | . | . | 14 | 1 | 5 | 2 | 32 | 40 | 3 | . | 57 |
| July 21, | . | 5 | 4 | 12 | 13 | . | . | . | 34 | 8 | 36 | 2 | 46 | 92 | . | 1 | 127 |
| Aug. 19, | . | . | 9 | 2 | 14 | . | . | . | 25 | 2 | . | . | 11 | 13 | 1 | 1 | 40 |
| Sept. 24, | 4 | 2 | . | 29 | 66 | . | . | . | 101 | 4 | 1 | . | 5 | 10 | . | 2 | 118 |
| Oct. 30, | 12 | 1 | 5 | 106 | 78 | . | . | . | 202 | 1 | 4 | . | 8 | 13 | 2 | . | 217 |
| Nov. 23, | 2 | 1 | . | 21 | 53 | . | . | . | 77 | . | . | . | 2 | 2 | 2 | 1 | 82 |
| Dec. 22, | . | . | 1 | 6 | 28 | . | . | . | 35 | . | . | 16 | . | 16 | . | 2 | 53 |
| | 25 | 17 | 24 | 216 | 318 | . | 1 | . | 601 | 26 | 72 | 87 | 120 | 305 | 12 | 33 | 951 |
| **St Andrews Bay—** | | | | | | | | | | | | | | | | | |
| **Station I** | | | | | | | | | | | | | | | | | |
| Feb. 13, | 21 | . | . | 1 | . | . | . | . | 22 | 2 | . | 3 | . | 5 | 1 | *29 | 57 |
| July 3, | 204 | . | . | 84 | 2 | . | . | . | 290 | . | . | . | 31 | 31 | . | . | 321 |
| July 22, | 86 | . | . | 40 | . | . | . | . | 126 | . | . | . | 19 | 19 | 3 | . | 148 |
| Aug. 25, | 40 | . | . | 80 | . | . | . | . | 120 | . | . | . | 35 | 35 | . | . | 155 |
| Oct. 2, | 21 | . | . | 11 | . | . | . | . | 32 | . | . | 1 | 12 | 13 | . | . | 45 |
| Nov. 6, | 13 | . | . | 81 | 1 | . | . | . | 95 | . | . | 3 | 6 | 9 | 2 | . | 106 |
| Dec. 9, | 6 | . | . | 67 | . | . | . | . | 73 | 1 | 3 | 2 | 15 | 21 | . | . | 94 |
| | 391 | . | . | 364 | 3 | . | . | . | 758 | 3 | 3 | 9 | 118 | 133 | 6 | 29 | 926 |
| **Station II.** | | | | | | | | | | | | | | | | | |
| Feb. 13, | 14 | 1 | . | 1 | . | . | . | . | 16 | 4 | . | 2 | . | 6 | 4 | 5 | 31 |
| July 3, | 96 | . | . | 28 | . | 1 | . | . | 125 | . | . | 3 | 15 | 18 | . | 1 | 144 |
| July 22, | 38 | . | . | 9 | . | . | . | . | 47 | . | . | . | 3 | 3 | . | . | 50 |
| Aug. 25, | 9 | . | . | 23 | . | . | . | . | 32 | . | . | . | 6 | 6 | . | . | 38 |
| Oct. 2, | 27 | . | . | 35 | . | . | . | . | 62 | 1 | 1 | . | 10 | 12 | 1 | . | 75 |
| Nov. 6, | 19 | . | . | 341 | . | . | . | . | 360 | . | . | . | 9 | 9 | 5 | 2 | 376 |
| | 203 | 1 | . | 437 | . | 1 | . | . | 642 | 5 | 1 | 5 | 43 | 54 | 10 | 8 | 714 |

* Sprats and Herrings.

TABLE A.—Showing Summary of Fish taken by the 'Garland' in Trawling Operations in 1891—*continued.*

| Station and Date. | Flat-Fish. | | | | | | | | | Round-Fish. | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Plaice. | Lemon Sole. | Witch Sole. | Common Dabs. | Long Roughs. | Flounder. | Turbot. | Brill. | Total. | Cod. | Haddock. | Whiting. | Gurnard. | Total. | Skate. | Other Fish. | Total. |
| St. Andrews Bay—*continued.* | | | | | | | | | | | | | | | | | |
| Station III. | | | | | | | | | | | | | | | | | |
| Feb. 13, . | 10 | 1 | . | 2 | 1 | . | . | . | 14 | 7 | . | 2 | . | 9 | . | 9 | 32 |
| July 8, . | 105 | . | . | 28 | 2 | 3 | . | . | 138 | . | 1 | 1 | 4 | 6 | 1 | . | 140 |
| July 22, . | 57 | . | . | 18 | . | . | . | . | 75 | . | 1 | . | 5 | 6 | 1 | . | 82 |
| Aug. 26, . | 30 | . | . | 48 | . | . | . | . | 78 | . | . | . | 12 | 12 | 1 | . | 91 |
| Oct. 2, . | 51 | . | . | 93 | 5 | . | . | . | 149 | . | . | 1 | 19 | 20 | . | 1 | 170 |
| Nov. 4, . | 85 | . | . | 302 | . | . | . | . | 387 | . | 1 | 2 | 45 | 48 | 3 | . | 438 |
| Dec. 14, . | 1 | . | . | 12 | . | . | . | . | 13 | . | 9 | 24 | 1 | 34 | . | *14 | 61 |
| | 289 | 1 | . | 498 | 8 | 3 | . | . | 799 | 7 | 12 | 30 | 86 | 135 | 6 | 24 | 964 |
| Station IV. | | | | | | | | | | | | | | | | | |
| Feb. 13, . | 19 | . | . | 3 | . | 3 | 1 | . | 26 | 3 | . | 3 | . | 6 | 6 | 15 | 53 |
| July 2, . | 125 | . | . | 38 | . | 1 | . | . | 164 | . | . | . | 22 | 22 | 3 | 2 | 191 |
| July 22, . | 23 | . | . | 48 | . | 4 | . | . | 75 | . | . | . | 45 | 45 | . | . | 120 |
| Aug. 24, . | 89 | . | . | 41 | . | 11 | . | . | 141 | . | . | . | 20 | 20 | . | . | 161 |
| Oct. 2, . | 39 | . | . | 11 | . | . | . | . | 50 | . | . | 2 | 8 | 10 | . | 1 | 61 |
| Nov. 4, . | 121 | . | . | 152 | . | . | . | . | 273 | 1 | 4 | 29 | 39 | 73 | 5 | †6 | 357 |
| Dec. 14, . | 7 | . | . | 16 | 3 | . | . | . | 26 | 4 | 28 | 5 | . | 37 | 1 | 3 | 67 |
| | 428 | . | . | 309 | 3 | 19 | 1 | . | 755 | 8 | 32 | 39 | 134 | 213 | 15 | 27 | 1010 |
| Station V. | | | | | | | | | | | | | | | | | |
| Feb. 12, . | 2 | 2 | . | 3 | 3 | . | . | . | 10 | 49 | 2 | 3 | . | 54 | 2 | ‡38 | 104 |
| July 2, . | 87 | . | . | 44 | 4 | 1 | . | . | 136 | . | 3 | 29 | 11 | 43 | . | . | 179 |
| July 22, . | 37 | . | . | 15 | 1 | 1 | . | . | 54 | . | . | 4 | 16 | 20 | . | . | 74 |
| Aug. 24, . | 70 | . | . | 95 | . | . | . | . | 165 | . | . | . | 13 | 13 | 1 | 1 | 180 |
| Oct. 1, . | 40 | . | . | 96 | 1 | . | . | . | 137 | . | 6 | 2 | 14 | 22 | . | . | 159 |
| Nov. 3, . | 57 | . | . | 1012 | . | . | . | . | 1069 | . | 1 | 1 | 31 | 33 | . | 3 | 1105 |
| | 293 | 2 | . | 1265 | 9 | 2 | . | . | 1571 | 49 | 12 | 39 | 85 | 185 | 3 | 42 | 1801 |
| Montrose— | | | | | | | | | | | | | | | | | |
| Station I. | | | | | | | | | | | | | | | | | |
| Aug. 28, . | 34 | . | . | 88 | 15 | . | . | . | 137 | 1 | 9 | . | 35 | 45 | 3 | . | 185 |
| Station II. | | | | | | | | | | | | | | | | | |
| Aug. 28, . | 19 | . | . | 12 | 1 | . | . | . | 32 | . | 3 | 1 | 7 | 11 | . | . | 43 |
| | 53 | . | . | 100 | 16 | . | . | . | 169 | 1 | 12 | 1 | 42 | 56 | 3 | . | 228 |
| Aberdeen— | | | | | | | | | | | | | | | | | |
| Station I. | | | | | | | | | | | | | | | | | |
| Sept. 3, . | 19 | . | . | 162 | . | . | . | . | 181 | 3 | 17 | 41 | 104 | 165 | . | 1 | 347 |
| Station II. | | | | | | | | | | | | | | | | | |
| Sept. 3, . | 13 | . | . | 183 | 2 | . | . | . | 198 | 3 | 15 | 54 | 10 | 82 | . | 1 | 281 |
| Station III. | | | | | | | | | | | | | | | | | |
| Sept. 3, . | 5 | | . | 72 | 1 | . | . | . | 78 | . | 18 | 122 | 6 | 146 | . | 1 | 225 |

* Sprats † Including 2 Soles. ‡ Herrings and Sprats.

TABLE A.—Showing Summary of Fish taken by the 'Garland' in Trawling Operations in 1891—*continued.*

| Station and Date. | Flat-Fish. | | | | | | | | | Round-Fish. | | | | | Skate. | Other Fish. | Total. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Plaice. | Lemon Sole. | Witch Sole. | Common Dabs. | Long Roughs. | Flounder. | Turbot. | Brill. | Total. | Cod. | Haddock. | Whiting. | Gurnard. | Total. | | | |
| **Aberdeen—** *continued.* | | | | | | | | | | | | | | | | | |
| Station IV. | | | | | | | | | | | | | | | | | |
| Sept. 5, . | 9 | . | . | 34 | . | . | . | . | 43 | 4 | 48 | 154 | 3 | 209 | . | . | 252 |
| Station V. | | | | | | | | | | | | | | | | | |
| Sept. 4, . | 65 | . | . | 30 | . | 12 | . | . | 107 | . | 32 | 151 | 1 | 184 | 4 | 2 | 297 |
| Station VI. | | | | | | | | | | | | | | | | | |
| Sept. 4, . | 7 | . | . | 153 | . | . | . | . | 160 | 3 | 167 | 237 | 1 | 408 | . | 2 | 570 |
| Station VII. | | | | | | | | | | | | | | | | | |
| Sept. 4, . | 4 | 1 | . | 12 | . | . | . | . | 17 | 7 | 425 | 695 | 5 | 1132 | . | . | 1149 |
| | 122 | 1 | . | 646 | 3 | 12 | . | . | 784 | 20 | 722 | 1454 | 130 | 2326 | 4 | 7 | 3121 |
| Moray Firth— | | | | | | | | | | | | | | | | | |
| Station I. | | | | | | | | | | | | | | | | | |
| Sept. 8, . | 3 | . | . | 18 | . | . | . | . | 21 | . | 5 | . | 18 | 23 | . | 1 | 45 |
| Station II. | | | | | | | | | | | | | | | | | |
| Sept. 8, . | 28 | 12 | 49 | 189 | 51 | 3 | . | . | 332 | 3 | 1 | 15 | 29 | 48 | 1 | 12 | 393 |
| Station III. | | | | | | | | | | | | | | | | | |
| Sept. 10, . | 54 | 5 | . | . | . | . | . | . | 59 | 4 | . | . | 1 | 5 | 2 | 3 | 69 |
| Station IV. | | | | | | | | | | | | | | | | | |
| Sept. 9, . | 111 | . | . | 122 | . | . | . | . | 233 | . | 1 | . | 10 | 11 | 1 | . | 245 |
| Station V. | | | | | | | | | | | | | | | | | |
| Sept. 9, . | 18 | 1 | . | 426 | . | 2 | . | . | 447 | . | 9 | 3 | 32 | 44 | . | . | 491 |
| Station VI. | | | | | | | | | | | | | | | | | |
| Sept. 9, . | 8 | 9 | . | 91 | . | . | . | . | 108 | 16 | 2 | . | 20 | 38 | 2 | 4 | 152 |
| | 222 | 27 | 49 | 846 | 51 | 5 | . | . | 1200 | 23 | 18 | 18 | 110 | 169 | 6 | 20 | 1395 |

## TABLE B.—ANALYSIS OF THE 'GARLAND'S' STATISTICS RELATING TO THE RELATIVE ABUNDANCE OF FISH.

### A. Showing the Average Per 'Shot' of each kind of Fish taken.

| Station. | Flat-Fish. | | | | | | | | | Round-Fish. | | | | | Skate. | Other Fish. | Total. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Plaice. | Lemon Sole. | Witch Sole. | Common Dabs. | Long Roughs. | Flounder. | Turbot. | Brill. | Total. | Cod. | Haddock. | Whiting. | Gurnard. | Total. | | | |
| **I. *Firth of Forth*, 1891.** | | | | | | | | | | | | | | | | | |
| **Closed Area.** | | | | | | | | | | | | | | | | | |
| I. | 23·1 | 30·8 | | 40·1 | 23·1 | 0·4 | – | – | 117·7 | 29·5 | 6·5 | 35·0 | 11·5 | 82·3 | 2·8 | 7·0 | 210·2 |
| II. | 54·5 | 7·5 | – | 61·5 | 16·7 | 1·1 | – | – | 141·4 | 8·2 | 15·7 | 17·4 | 9·3 | 50·7 | 1·6 | 2·3 | 196·1 |
| III. | 15·6 | 24·0 | – | 38·2 | 21·0 | 0·5 | – | – | 99·5 | 26·7 | 5·0 | 54·4 | 13·5 | 99·6 | 2·5 | 5·5 | 207·2 |
| IV. | 141·4 | 7·0 | – | 33·6 | 6·4 | 0·2 | – | 0·0 | 188·9 | 8·5 | 0·0 | 17·3 | 20·1 | 46·0 | 4·2 | 8·0 | 247·2 |
| V. | 15·7 | 7·7 | 2·1 | 11·4 | 43·8 | 0·0 | – | 0·0 | 81·0 | 15·8 | 28·8 | 19·5 | 15·6 | 79·8 | 0·9 | 3·4 | 165·2 |
| VI. | 38·1 | 10·5 | – | 17·7 | 1·1 | 0·2 | 0·1 | 0·8 | 68·9 | 5·5 | 1·0 | 5·3 | 12·0 | 24·0 | – | 3·0 | 95·9 |
| VII. | 16·3 | 4·4 | 0·4 | 62·0 | 23·5 | 0·8 | 0·0 | – | 107·6 | 3·4 | 38·4 | 26·4 | 23·3 | 91·5 | 2·1 | 2·3 | 203·7 |
| Average per shot of 84 shots. | 43·5 | 13·2 | 0·3 | 37·7 | 19·4 | 0·5 | 0·0 | 0·1 | 115·0 | 13·9 | 13·6 | 25·0 | 15·0 | 67·7 | 2·0 | 4·5 | 189·4 |
| **Unclosed Area.** | | | | | | | | | | | | | | | | | |
| VIII. | 3·4 | 1·3 | 1·4 | 14·9 | 25·6 | 0·0 | 0·0 | – | 47·0 | 2·3 | 17·2 | 10·0 | 19·8 | 49·6 | 1·9 | 1·1 | 99·7 |
| IX. | 2·2 | 1·5 | 2·1 | 19·6 | 28·9 | – | 0·0 | – | 54·6 | 2·3 | 6·5 | 7·9 | 10·9 | 27·7 | 1·0 | 8·0 | 86·4 |
| Average per shot of 22 shots. | 2·8 | 1·4 | 1·8 | 17·2 | 27·2 | 0·0 | 0·0 | – | 50·8 | 2·3 | 11·9 | 9·0 | 15·3 | 38·6 | 1·5 | 2·0 | 93·0 |
| **II. *St Andrews Bay*, 1891.** | | | | | | | | | | | | | | | | | |
| **Closed Area.** | | | | | | | | | | | | | | | | | |
| I. | 55·8 | – | – | 52·0 | 0·4 | – | – | – | 108·2 | 0·4 | 0·4 | 1·2 | 16·8 | 19·0 | 0·8 | 4·1 | 132·2 |
| II. | 33·8 | 0·1 | – | 72·8 | – | 0·1 | – | – | 107·0 | 0·8 | 0·1 | 0·8 | 7·1 | 9·0 | 1·6 | 1·3 | 119·0 |
| III. | 41·2 | 0·1 | – | 71·1 | 1·1 | 0·4 | – | – | 114·1 | 1·0 | 1·7 | 4·2 | 12·2 | 19·2 | 0·8 | 3·4 | 137·7 |
| IV. | 60·4 | – | – | 44·1 | 0·4 | 2·7 | 0·1 | – | 107·8 | 1·1 | 4·5 | 5·5 | 19·1 | 30·4 | 2·1 | 3·8 | 144·2 |
| Average per shot of 27 shots. | 48·3 | 0·0 | – | 59·5 | 0·5 | 0·8 | 0·0 | – | 109·4 | 0·8 | 1·7 | 3·0 | 14·1 | 19·8 | 1·3 | 3·2 | 133·8 |
| **Unclosed Area.** V. Average of 6 shots. | 48·8 | 0·3 | – | 210·8 | 1·5 | 0·3 | – | – | 261·8 | 8·1 | 2·0 | 6·5 | 14·1 | 30·8 | 0·5 | 7·0 | 300·1 |
| **III. *Montrose, August* 1891.** | | | | | | | | | | | | | | | | | |
| Average of 2 shots. | 26·5 | – | – | 50·0 | 8·0 | – | – | – | 84·5 | 0·5 | 6·0 | 0·5 | 21·0 | 28·0 | 1·5 | · | 114·0 |
| **IV. *Aberdeen, September* 1891.** | | | | | | | | | | | | | | | | | |
| Average of 7 shots. | 17·4 | 0·1 | – | 92·2 | 0·4 | 1·7 | – | – | 112·0 | 2·8 | 103·1 | 207·7 | 18·5 | 332·2 | 0·5 | 1·0 | 445·8 |
| **V. *Moray Firth, September* 1891.** | | | | | | | | | | | | | | | | | |
| Average of 6 shots. | 37·0 | 4·5 | 8·1 | 141·0 | 8·5 | 0·8 | – | – | 200·0 | 3·8 | 3·0 | 3·0 | 18·3 | 28·1 | 1·0 | 3·3 | 232·5 |

## B. Showing the Monthly Average per 'Shot' of each kind of Fish taken in 1891.

| Date. | Flat-Fish. | | | | | | | | | Round-Fish. | | | | | Skate. | Other Fish. | Total. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Plaice. | Lemon Sole. | Witch Sole. | Common Dabs. | Long Roughs. | Flounder. | Turbot. | Brill. | Total. | Cod. | Haddock. | Whiting. | Gurnard. | Total. | | | |
| **I. *Firth of Forth.*** | | | | | | | | | | | | | | | | | |
| **Closed Area.** | | | | | | | | | | | | | | | | | |
| Jan. | 16·8 | 3·5 | 0·5 | 6·2 | 21·4 | 0·1 | – | 0·1 | 49·0 | 53·8 | 2·1 | 50·2 | 0·1 | 106·4 | 2·4 | 3·2 | 161·1 |
| Feb. | 31·4 | 4·8 | 0·2 | 21·4 | 16·5 | 0·2 | – | – | 74·7 | 13·2 | 1·1 | 5·4 | – | 19·8 | 0·8 | 4·1 | 99·7 |
| Mar. | 42·8 | 11·1 | 1·0 | 17·8 | 9·1 | 3·0 | – | 0·1 | 85·1 | 25·2 | 4·8 | 17·4 | 0·4 | 48·0 | 4·0 | 4·4 | 141·5 |
| April | 34·2 | 14·2 | 0·4 | 19·0 | 12·2 | 1·5 | – | – | 81·8 | 14·4 | 3·1 | 12·4 | 26·1 | 56·1 | 3·4 | 5·4 | 146·8 |
| May | 62·2 | 17·1 | 1·0 | 33·5 | 17·0 | 0·2 | – | – | 131·2 | 8·7 | 5·2 | 3·0 | 47·5 | 64·5 | 1·7 | 7·2 | 204·8 |
| June | 81·1 | 20·5 | 0·5 | 64·0 | 20·2 | 0·5 | 0·1 | – | 187·2 | 10·0 | 42·7 | 15·2 | 39·8 | 107·8 | 2·5 | 2·5 | 300·2 |
| July | 65·1 | 29·1 | 0·1 | 47·0 | 24·5 | 0·1 | – | 0·1 | 166·2 | 11·7 | 41·7 | 10·0 | 18·2 | 81·7 | 2·0 | 4·4 | 254·4 |
| August | 42·5 | 14·8 | 0·1 | 47·0 | 11·8 | – | – | – | 116·4 | 6·7 | 16·0 | 5·1 | 15·0 | 42·8 | 1·4 | 3·5 | 164·2 |
| Sept. | 49·1 | 14·5 | – | 30·0 | 11·0 | – | – | – | 104·7 | 9·4 | 14·5 | 28·2 | 17·5 | 69·8 | 2·0 | 2·4 | 179·0 |
| Oct. | 34·8 | 14·4 | 0·2 | 79·2 | 39·2 | – | 0·1 | 0·2 | 168·5 | 5·7 | 6·8 | 80·0 | 13·1 | 105·7 | 1·0 | 9·0 | 284·2 |
| Nov. | 45·5 | 6·4 | – | 50·7 | 26·2 | – | – | 0·5 | 129·5 | 3·7 | 11·1 | 32·1 | 2·1 | 49·1 | 1·7 | 3·8 | 184·2 |
| Dec. | 16·7 | 8·5 | – | 36·2 | 23·4 | – | 0·1 | 0·4 | 85·5 | 4·8 | 14·4 | 41·4 | 0·7 | 61·4 | 1·4 | 3·7 | 152·1 |
| **Unclosed Area.** | | | | | | | | | | | | | | | | | |
| Jan. | 1·0 | 0·5 | 0·5 | 2·0 | 16·5 | – | – | – | 20·5 | 4·5 | 5·5 | 26·0 | – | 36·0 | 1·0 | 6·5 | 64·0 |
| Feb. | 0·5 | 0·5 | – | 17·5 | 23·5 | – | – | – | 42·0 | 1·5 | 7·0 | 8·0 | 0·5 | 17·0 | 1·0 | 1·0 | 61·0 |
| Mar. | – | No | tra | wling | – | – | – | – | – | – | – | – | – | – | – | – | – |
| April | 2·5 | 3·0 | 2·0 | 11·0 | 8·0 | – | 0·5 | – | 27·0 | 5·5 | 7·5 | 28·0 | 14·5 | 55·5 | 1·0 | 7·5 | 91·0 |
| May | 1·0 | 2·0 | 4·5 | 17·5 | 26·0 | – | 0·5 | – | 51·5 | 0·5 | 8·5 | 6·5 | 24·5 | 40·0 | 4·5 | 2·0 | 98·0 |
| June | 1·5 | 4·5 | 0·5 | 9·0 | 22·5 | – | – | – | 38·0 | 2·0 | 41·5 | 1·0 | 50·5 | 95·0 | 1·5 | 1·0 | 135·5 |
| July | 6·0 | 3·0 | 4·0 | 20·0 | 18·0 | – | – | – | 51·0 | 5·5 | 40·0 | 4·0 | 55·0 | 104·5 | 2·0 | 1·5 | 159·0 |
| August | 4·0 | – | 5·0 | 5·5 | 18·0 | 0·5 | – | – | 33·0 | 1·5 | 10·0 | 6·0 | 10·5 | 28·0 | 0·5 | 0·5 | 62·0 |
| Sept. | 2·5 | 1·0 | – | 22·0 | 49·0 | – | – | – | 74·5 | 4·0 | 4·0 | 7·0 | 2·5 | 17·5 | – | 1·0 | 93·0 |
| Oct. | 10·0 | 0·5 | 3·0 | 69·0 | 75·5 | – | – | – | 158·0 | 0·5 | 4·5 | 1·5 | 10·0 | 16·5 | 3·5 | 0·5 | 178·5 |
| Nov. | 2·0 | 0·5 | – | 12·5 | 29·0 | – | – | – | 44·0 | – | 2·0 | 3·5 | 1·0 | 6·5 | 1·5 | 0·5 | 52·5 |
| Dec. | 0·5 | 0·5 | 0·5 | 4·0 | 14·0 | – | – | – | 19·5 | 0·5 | 0·5 | 3·0 | – | 9·0 | – | 1·0 | 29·5 |
| **II. *St Andrews Bay.*** | | | | | | | | | | | | | | | | | |
| **Closed Area.** | | | | | | | | | | | | | | | | | |
| Feb. | 16·0 | 0·5 | – | 1·7 | 0·2 | 0·7 | 0·2 | – | 19·5 | 4·0 | – | 2·5 | – | 6·5 | 2·7 | 14·5 | 43·2 |
| June | 132·5 | – | – | 43·2 | 1·0 | 1·2 | – | – | 178·0 | – | 0·2 | 1·0 | 18·0 | 19·2 | 1·0 | 0·7 | 199·0 |
| July | 51·0 | – | – | 28·7 | – | 1·0 | – | – | 80·7 | – | 0·2 | – | 18·0 | 18·2 | 1·0 | – | 100·0 |
| August | 42·0 | – | – | 48·0 | – | 2·7 | – | – | 92·7 | – | – | – | 18·2 | 18·2 | 0·2 | – | 111·2 |
| Oct. | 34·5 | – | – | 37·5 | 1·2 | – | – | – | 73·2 | 0·2 | 0·2 | 1·0 | 12·2 | 13·7 | 0·2 | 0·5 | 87·7 |
| Nov. | 47·0 | – | – | 219·0 | 0·2 | – | – | – | 266·2 | 0·2 | 1·2 | 8·5 | 24·7 | 34·7 | 3·7 | 2·0 | 306·7 |
| Dec. | 4·6 | – | – | 31·6 | 1·0 | – | – | – | 37·3 | 1·6 | 13·3 | 10·3 | 5·3 | 30·6 | 0·3 | 5·6 | 74·0 |
| **Unclosed Area.** | | | | | | | | | | | | | | | | | |
| Feb. | 2 | 2 | – | 3 | 3 | – | – | – | 10 | 49 | 2 | 3 | – | 54 | 2 | 38 | 104 |
| June | 87 | – | – | 44 | 4 | 1 | – | – | 136 | – | 3 | 29 | 11 | 43 | – | – | 179 |
| July | 37 | – | – | 15 | 1 | 1 | – | – | 54 | | – | 4 | 16 | 20 | – | – | 74 |
| August | 70 | – | – | 95 | – | – | – | – | 165 | – | – | – | 13 | 13 | 1 | 1 | 180 |
| Oct. | 40 | – | – | 96 | 1 | – | – | – | 137 | – | 6 | 2 | 14 | 22 | – | – | 159 |
| Nov. | 57 | – | – | 1012 | – | – | – | – | 1069 | – | 1 | 1 | 31 | 33 | – | 3 | 1105 |
| Dec. | – | – | – | – | – | – | No | tra | wling | – | – | – | – | – | – | – | – |

## LIST OF COMMON AND SCIENTIFIC NAMES (DAY) OF FISH MENTIONED IN THE RETURNS.

| | |
|---|---|
| Angler, | *Lophius piscatorius.* |
| Brassie, or Bib, | *Gadus luscus.* |
| Brill, | *Rhombus lævis.* |
| Butter-fish, | *Centronotus gunnellus.* |
| Cat-fish, | *Anarrhichas lupus.* |
| Coal-fish, | *Gadus Virens.* |
| Cod, | *Gadus morrhua.* |
| Conger, | *Conger vulgaris.* |
| Dab, common, | *Pleuronectes limanda.* |
| ,, lemon, | ,, *microcephalus.* |
| ,, long rough, | *Hippoglossoides limandoides.* |
| Dog-fish, picked, | *Acanthias vulgaris.* |
| Dragonet, | *Callionymus lyra.* |
| Father-lasher, | *Cottus scorpius.* |
| Flounder, | *Pleuronectes flesus.* |
| Fluke, sail, | *Arnoglossus megastoma.* |
| Gurnard, common, | *Trigla gurnardus.* |
| ,, red, | ,, *hirundo.* |
| Haddock, | *Gadus æglefinus.* |
| Hake, | *Merluccius vulgaris.* |
| Herring, | *Clupea harengus.* |
| John Dory, | *Zeus faber.* |
| Ling, | *Molva vulgaris.* |
| Lump-sucker, | *Cyclopterus lumpus.* |
| Plaice, | *Pleuronectes platessa.* |
| Pogge, | *Agonus cataphractus.* |
| Ray, sandy, | *Raia circularis.* |
| ,, starry, | ,, *radiata.* |
| ,, thornback, | ,, *clavata.* |
| Rockling, four-bearded, | *Motella cimbria.* |
| Saithe, | *Gadus virens.* |
| Skate, gray, | *Raia batis.* |
| Sole, | *Solea vulgaris.* |
| ,, black, | ,, ,, |
| ,, witch, | *Pleuronectes cynoglossus.* |
| Sprat, | *Clupea sprattus.* |
| Turbot, | *Rhombus maximus.* |
| Whiting, | *Gadus merlangus.* |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1891.—I. FIRTH OF FORTH.

E. before the figures indicating temperature means east end of station; W., west; N., north; and S., south.

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Temperature. Water. Surface. | Temperature. Water. Bottom. | Pelagic Fauna, Spawn, and young Fish.* | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c., brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION I. 15th Jan. 1.30 p.m. to 3.40 p.m. | E. 39·0 | 5·5 | 5·4 15 fath. | Surface-net. — *Boreophausia*, sp. r.; *Parathemisto oblivia*, c.; *Idotea marina*, r.; *Calanus finmarchicus*, c.; *Sagitta*, sp. f.; small Ctenophora, f. | Starry ray,† | 1 | 11 | ... | ... | ... | ... | | At beginning—Wind W.N.W., force 6; sky overcast; sea, rough; tide, first ¼ flood; barometer, 30·31; transparency, 2½ fathoms. At finish—Wind W.N.W., force 5; dull and hazy; sea moderate; tide, ½ flood; barometer, 30·25; transparency, 2 fathoms. |
| | | | | | Thornback ray, | 1 | 22 | 1 | 23 | 1 | 16 | | |
| | | | | | " " | 1 | 12 | 1 | 11 | ... | ... | | |
| | | | | | Plaice, | 1 | 16 | ... | ... | ... | ... | | |
| | W. 41·0 | 5·1 | 5·2 13 fath. | | Lemon soles, | 4 | 13 | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 9 | 7 | 1 | 6 | 3 | 5 | | |
| | | | | | Long rough dabs, | 2 | 12 | 2 | 10 | 9 | 8 | | |
| | | | | | " " | 11 | 7 | ... | ... | ... | ... | | |
| | | | | | Cod, | 1 | 26 | 1 | 23 | 3 | 16 | | |
| | | | | | " | 12 | 15 | 51 | 13 | 31 | 10 | | |
| | | | | | " | 31 | 8 | 7 | 7 | 5 | 6 | | |
| | | | | | " | 2 | 5 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 1 | 16 | 4 | 14 | 7 | 12 | | |
| | | | | | " | 45 | 11 | 7 | 10 | 43 | 9 | | |
| | | | | | " | 25 | 8 | 12 | 7 | 10 | 6 | | |
| | | | | | Herrings, | 2 | 11 | ... | ... | ... | ... | | |
| | | | | | Angler, | 1 | 26 | 3 | 14 | ... | ... | | |
| | | | | | Father-lasher, | 1 | 7 | ... | ... | ... | ... | | |
| | | | | | Pogge, | 1 | 2½ | ... | ... | ... | ... | | |
| | | | | | Cat-fish, | 2 | 33 | ... | ... | ... | ... | | |
| STATION II. 15th Jan. 11.0 a.m. to 1.0 p.m. | E. 40·0 | 5·5 | 5·5 12 fath. | Surface-net. — *Parathemisto oblivia*, f.; *Hyperia*, sp. r.; *Calanus finmarchicus*, fr.; *Sagitta*, sp. fr.; small Ctenophora, f. | Grey skate, | 1 | 10 | ... | ... | ... | ... | | At beginning—Wind, W.N.W., force, 6; weather, overcast; sea, rough; |
| | | | | | Thornback ray, | 2 | 14 | 3 | 9 | ... | ... | | |
| | | | | | Plaice, | 1 | 15 | 1 | 13 | ... | ... | | |
| | | | | | Lemon sole, | 1 | 10 | ... | ... | ... | ... | | |

* sp.=species unidentified; juv.=young; r.=rare; f.=few; fr=frequent; com.=common; a.=abundant; v.a.=very abundant.
† The measurement of skates and rays is a measurement of width, and not of length.

TABLE C.—Record of Observations made on Board the 'Garland' during 1891.—I. Firth of Forth—*continued.*

| Station. Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Temperature. Water. Surface. | Temperature. Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c., brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station II. | W. 39·0 | 5·2 | 5·4 | | Common dab, | 1 | 7 | 3 | 6 | ... | ... | | tide, 5 hours ebb; |
| 15th Jan. | | | 13 | | Long rough dab, | 1 | 11 | 1 | 9 | 6 | 8 | | barometer, 30·42; |
| 11 a.m. to | | | fath. | | " " | 5 | 7 | 5 | 5 | ... | ... | | transparency, 2¼ |
| 1.0 p.m. | | | | | Haddock, | 1 | 11 | ... | ... | ... | ... | | fathoms. |
| —*continued.* | | | | | Cod, | 1 | 33 | 1 | 31 | 1 | 30 | | At finish—Wind, |
| | | | | | " | 2 | 29 | 3 | 26 | 3 | 22 | | weather, and sea as |
| | | | | | " | 1 | 18 | 4 | 16 | 5 | 12 | | before; tide, 1 hour |
| | | | | | " | 6 | 10 | 5 | 9 | 5 | 8 | | flood; barometer, |
| | | | | | " | 7 | 6 | 6 | 5 | 2 | 4 | | 30·33; transparency, |
| | | | | | Whitings, | 2 | 12 | 5 | 9 | 4 | 8 | | 2½ fathoms. |
| | | | | | " | 4 | 7 | 14 | 6 | 6 | 5 | | |
| | | | | | Herring, | 1 | 7 | ... | ... | ... | ... | | |
| Station III. | E. 36·0 | 4·0 | 4·0 | Bottom-net.—*Mysidop-* | Lemon soles, | 1 | 12 | | 10 | 1 | 9 | | At beginning— |
| 19th Jan. | | | 8 | *sis gibbosa*, r.; *Macropsis* | " " | 1 | 8 | ... | ... | ... | ... | | Wind W., force 7; |
| 11.0 a.m. to | | | fath. | *slabberi*, f.; *Boreophausia*, | Common dabs, | 1 | 12 | 2 | 9 | 3 | 5 | | weather, dull and |
| 2.0. p.m. | | | | sp. f.; *Parathemisto ob-* | " " | 1 | 4 | ... | ... | ... | ... | | cloudy; sea, rough, |
| | | | | *livia*, f.; *Calanus finmar-* | Long rough dabs, | 1 | 13 | 3 | 10 | 16 | 9 | | tide, 1 hour ebb; |
| | W. 39·0 | 4·5 | 5·0 | *chicus*, fr.; *Caligus rapax* | " " | 1 | 8 | 8 | 7 | 5 | 6 | | barometer, 30·03; |
| | | | 8 | (with *Udonella caligorum* | Flounder, | 1 | 8 | ... | ... | ... | ... | | transparency, 2¾ |
| | | | fath. | attached), fr.; *Sagitta*, sp. | Cod, | 1 | 35 | 1 | 30 | 1 | 28 | | fathoms. |
| | | | | c.; *Tomopteris*, sp. fr.; | " | 4 | 27 | 3 | 22 | 7 | 17 | | At finish—Wind |
| | | | | small Ctenophora, f. | " | 14 | 14 | 37 | 11 | 32 | 9 | | W., force 6; cloudy |
| | | | | | " | 17 | 8 | 8 | 6 | 4 | 5 | | and sunshine; sea, |
| | | | | | Whitings, | 1 | 15 | 2 | 14 | 3 | 12 | | moderate; tide, 4 |
| | | | | | " | 4 | 11 | 6 | 10 | 37 | 9 | | hours ebb; transpa- |
| | | | | | " | 25 | 8 | 8 | 7 | 4 | 6 | | rency, 2½ fathoms. |
| | | | | | Ling, | 1 | 23 | ... | ... | ... | ... | | |
| | | | | | Herrings, | 3 | 7 | ... | ... | ... | ... | | |
| | | | | | Sprats, | 3 | 4 | ... | ... | ... | ... | | |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1891.—I. FIRTH OF FORTH—*continued.*

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Water. Surface. | Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c., brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION IV. 24th Jan. 11.0 a.m. to 1.30 p.m. | E. 41·0 | 3·9 | 3·9 7 fath. | Surface-net. — *Boreophausia*, sp. fr.; *Calanus finmarchicus*, fr.; *Parathemisto oblivia*, fr.; *Sagitta*, f.; small Ctenophora. Bottom-net. — *Mysis spiritus*, r.; *Macropsis slabberi*, r.; *Boreophausia*, sp. f.; *Parathemisto oblivia*, r.; *Calanus finmarchicus*, fr.; *Caligus rapax*, f.; *Sagitta*, sp. fr.; *Tomopteris*, f.; small Ctenophora, f.; young pipe fish (*Syngnathus*), 1. | Thornback ray, | 1 | 12 | ... | ... | ... | ... | | At beginning—Wind W.S.W., force 6; weather, cloudy; sea, rough; tide, nearly ½ flood; barometer, 29·22; transparency, 2 fathoms. At finish—Wind, W., force 4; sea, slight; tide, 5 hours flood; transparency, 2 fathoms. |
| | | | | | Plaice, | 3 | 17 | 5 | 16 | 15 | 15 | | |
| | | | | | " | 44 | 13 | 17 | 12 | 6 | 11 | | |
| | W. 41·0 | 4·2 | 4·0 7 fath. | | " | 4 | 10 | 2 | 9 | 1 | 7 | | |
| | | | | | Common dabs, | 1 | 10½ | 1 | 7½ | ... | ... | | |
| | | | | | Long rough dabs, | 1 | 9 | ... | ... | ... | ... | | |
| | | | | | Cod, | | 21 | 1 | 9 | ... | ... | | |
| STATION V. 21st Jan. 11.30 a.m. to 2.10 p.m. | W. 38·0 | 5·4 | 6·0 29 fath. | | Starry ray, | 1 | 7 | ... | ... | ... | ... | | At beginning—Wind W.N.W., force 3; weather, dull and cloudy; sea, slight; tide, nearly high water; barometer 29·26; transparency 3¼ fathoms. At finish—Wind W.N.W., force 4; fine clear weather; sea, slight; tide, 2 hours ebb; barometer, 29·28; transparency, 4 fathoms. |
| | | | | | Plaice, | 1 | 15 | ... | ... | ... | ... | | |
| | | | | | Lemon soles, | 1 | 14 | 1 | 10 | 1 | 9 | | |
| | | | | | " " | 1 | 7 | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 1 | 11 | 2 | 8 | 2 | 7 | | |
| -- | E. 38·0 | 5·8 | 6·0 28 fath. | | " " | 3 | 6 | ... | ... | ... | ... | | |
| | | | | | Witch soles, | 2 | 18 | 1 | 17 | 1 | 15 | | |
| | | | | | Long rough dabs, | 1 | 10 | 8 | 9 | 24 | 8 | | |
| | | | | | " " | 11 | 7 | 6 | 6 | 6 | 5 | | |
| | | | | | Brill, | 1 | 17 | ... | ... | ... | ... | | |
| | | | | | Haddocks, | 2 | 16 | 1 | 13 | 6 | 11 | | |
| | | | | | " | 4 | 10 | ... | ... | ... | ... | | |
| | | | | | Cod, | 1 | 37 | 1 | 28 | 1 | 23 | | |
| | | | | | " | 1 | 21 | 2 | 16 | 3 | 14 | | |

TABLE C.—Record of Observations made on Board the 'Garland' during 1891.—I. Firth of Forth—*continued.*

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Water. Surface. | Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c., brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station V. 21st Jan. 11.30 a.m. to 2.10 p.m. —*continued.* | | | | | Cod, | 5 | 11 | 9 | 9 | 3 | 8 | | |
| | | | | | Whitings, | 8 | 13 | 5 | 12 | 14 | 9 | | |
| | | | | | „ | 6 | 8 | 4 | 7 | 1 | 6 | | |
| | | | | | „ | 2 | 5 | ... | ... | ... | ... | | |
| | | | | | Ling, | 1 | 16 | ... | ... | ... | ... | | |
| | | | | | Common gurnard, | 1 | 4 | ... | ... | ... | ... | | |
| | | | | | Cat-fish, | 1 | 25 | 1 | 22 | ... | ... | | |
| Station VI. 21st Jan. 2.50 p.m. to 3.55 p.m. | E. 35·0 | 5·1 | 5·2 14 fath. | | Plaice, | 1 | 20 | 8 | 16 | 3 | 15 | | At beginning—Wind W.N.W., force 4; weather, fine; tide, ½ ebb; sea, moderate; barometer, 29·28; transparency, 3 fathoms. At finish—Tide, 4 hours ebb; barometer 29·28; transparency, 2¾ fathoms. |
| | | | | | „ | 3 | 13 | 1 | 11 | ... | ... | | |
| | | | | | Lemon soles, | 2 | 15 | 3 | 14 | 4 | 13 | | |
| | | | | | „ „ | 1 | 12 | 1 | 8 | ... | ... | | |
| | | | | | Common dabs, | 3 | 8 | 4 | 6½ | 1 | 5 | | |
| | W. 34·0 | 5·5 | 5·5 15 fath. | | Long rough dabs, | 2 | 8 | ... | ... | ... | ... | | |
| | | | | | Haddock, | 1 | 18 | ... | ... | ... | ... | | |
| | | | | | Cod, | 1 | 20 | 1 | 18 | 2 | 9 | | |
| | | | | | „ | 3 | 6 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 1 | 12 | 1 | 11 | 1 | 7 | | |
| | | | | | Dragonet, | 1 | 8 | ... | ... | ... | ... | | |
| Station VII. 12th Jan. 11.50 a.m. to 2.0 p.m. | E. 46·0 | 5·0 | 5·0 18 fath. | | Starry ray, | 1 | 9 | 1 | 7 | 1 | 5 | | At beginning—Wind W.S.W., force 5; dull and hazy; sea, slight; tide, nearly ½ flood; barometer, 30·46; transparency, 2¼ fathoms. At finish—Wind W.S.W.; force 7; |
| | | | | | Plaice, | 2 | 15 | 1 | 12 | 3 | 8 | | |
| | | | | | Lemon sole, | 1 | 12 | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 1 | 8 | 1 | 5 | ... | ... | | |
| | | | | | Long rough dabs, | 1 | 11 | 1 | 9 | 6 | 7 | | |
| | W. 43·0 | 4·3 | 4·5 12 fath. | | „ „ | 2 | 6 | 5 | 5 | ... | ... | | |
| | | | | | Cod, | 1 | 22 | 1 | 16 | 1 | 15 | | |
| | | | | | „ | 2 | 9 | 1 | 13 | 2 | 8 | | |
| | | | | | „ | 2 | 7 | 5 | 4½ | ... | ... | | |

TABLE C.—Record of Observations made on Board the 'Garland' during 1891.—I. Firth of Forth—*continued.*

| Station, Date, and Time Trawl down. | Temperature. | | | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. | | | | | | Invertebrate Fauna, &c., brought up in Trawl Net. | Wind Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Air. | Water. | | | | | | | | | | | |
| | Dry Bulb. | Surface. | Bottom. | | | No. | Inches | No. | Inches | No. | Inches | | |
| Station VII. 12th Jan. 11.50 a.m. to 2.0 p.m. —*continued.* | | | | | Whitings, . . | 1 | 12 | 1 | 9 | 4 | 8 | | sea, rough; tide, last ½ flood; barometer, 30·45; transparency, 2½ fathoms. |
| | | | | | ,, . . | 4 | 7 | 19 | 6 | 11 | 5 | | |
| | | | | | Dragonet, . . | 1 | 7 | ... | ... | ... | ... | | |
| Station VIII. 29th Jan. 11.45 a.m. to 1.30 p.m. | S.W. 45·0 | 4·9 | 5·3 20 fath. | | Thornback ray, . | 1 | 19 | ... | ... | ... | ... | | At beginning—Wind S.S.E., force 4; weather, cloudy; sea, rough; tide, first half of flood; barometer, 29·51; transparency 4 fathoms. At finish—Wind S.; force 5; tide, 2 hours flood; barometer, 29·46; transparency 4 fathoms. |
| | | | | | Plaice, . . | 1 | 24 | 1 | 18 | ... | ... | | |
| | | | | | Common dabs, . | 1 | 10 | 1 | 8 | 1 | 7 | | |
| | | | | | ,, ,, . | 1 | 6 | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 1 | 9 | 4 | 8 | 7 | 7 | | |
| | | | | | ,, ,, . | 3 | 6 | 2 | 5 | ... | ... | | |
| | N.E. 44·0 | 5·1 | 5·2 27 fath. | | Haddocks, . . | 1 | 15 | 4 | 10 | ... | ... | | |
| | | | | | Cod, . . . | 4 | 9 | ... | ... | ... | ... | | |
| | | | | | Whitings, . . | 1 | 12 | 1 | 11 | 5 | 9 | | |
| | | | | | ,, . . | 6 | 8 | 5 | 7 | 4 | 6 | | |
| | | | | | ,, . . | 2 | 5 | ... | ... | ... | ... | | |
| | | | | | Angler, . . | 1 | 25 | 1 | 8 | ... | ... | | |
| Station IX. 29th Jan. 2.10 p.m. to 4.0. p.m. | S.E. 44·0 | 5·0 | 5·3 32 fath. | | Starry ray, . . | 1 | 8 | ... | ... | ... | ... | | At beginning—Wind S., force 5; weather, dull and cloudy; sea, rough; tide, nearly ½ flood; barometer, 29·44; transparency, 8¾ fathoms. A finish—Wind S.W., force 5; tide, |
| | | | | | Lemon sole, . | 1 | 15 | ... | ... | ... | ... | | |
| | | | | | Witch soles, . | 1 | 16 | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 2 | 8 | 6 | 7 | 5 | 6 | | |
| | | | | | ,, ,, . | 3 | 5 | ... | ... | ... | ... | | |
| | N.W. 44·0 | 5·5 | 5·6 30 fath. | | Haddocks, . . | 1 | 11 | 4 | 10 | 1 | 9 | | |
| | | | | | Cod, . . . | 1 | 28 | 1 | 13 | 1 | 10 | | |
| | | | | | ,, . . . | 1 | 9 | 1 | 8 | ... | ... | | |
| | | | | | Whiting, . . | 1 | 14 | 1 | 10 | 8 | 9 | | |
| | | | | | ,, . . | 12 | 8 | 6 | 7 | ... | ... | | |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1890.—I. FIRTH OF FORTH—*continued.*

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Water. Surface. | Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c., brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION IX. 29th Jan. 2.10 p.m. to 4.0 p.m. —*continued.* | | | | | Ling, . . . | 1 | 22 | ... | ... | ... | ... | | last ¼ flood; barometer, 29·44; transparency, 4 fathoms. |
| | | | | | Brassie, . . . | 1 | 9 | 1 | 8 | 2 | 7 | | |
| | | | | | Angler, . . . | 1 | 28 | 3 | 14 | 1 | 11 | | |
| | | | | | Cat-fish, . . . | 1 | 21 | ... | ... | ... | ... | | |
| STATION I. 23rd Feb. 10.55 a.m. to 1.0 p.m. | W. 44·0 | 5·2 | 5·3 9 fath. | Surface-net. — *Calanus finmarchicus*, f.; *Dias longiremis*, fr.; *Parathemisto*, sp. f.; *Boreophausia*, sp. r.; Infusoria (*Ceratium*, &c.), fr. Bottom-net. — *Parathemisto*, sp. r.; *Hyperia*, sp. r.; *Calanus finmarchicus*, fr.; *Dias longiremis*, f.; *Temora longicornis*, f.; *Sagitta*, sp. f.; Ctenophora, f. | Thornback ray, . | 1 | 12 | ... | ... | ... | ... | *Ophiothrix rosula*, f.; *Asterias*, sp. f.; *Solaster papposa*, f.; *Nephrops norvegicus*, r.; *Pecten opercularis*, c.; *Mytilis modiolus*, f.; a few fragments of *Alcyonium*, sp. | At beginning—Wind calm, force 0; weather, thick fog; sea, smooth; tide, about 2 hours flood; barometer, 30·28; transparency, 3 fathoms. At finish—Wind, weather, and sea as before; tide, 4 hours flood; barometer, 30·28; transparency, 4 fathoms. |
| | | | | | Plaice, . . | 2 | 14 | 1 | 12 | 1 | 11 | | |
| | | | | | Lemon soles, . | 1 | 15 | 4 | 12½ | 4 | 10 | | |
| | | | | | ,, ,, . . | 2 | 8 | ... | ... | ... | ... | | |
| | | | | | Common dabs, . | 2 | 9 | 15 | 8 | 15 | 6½ | | |
| | E. 46·0 | 5·2 | 5·4 | | ,, ,, . | 10 | 5 | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 2 | 9 | 5 | 8 | 7 | 7 | | |
| | | | | | ,, ,, | 5 | 6 | ... | ... | ... | ... | | |
| | | | | | Cod, . . . | 1 | 32 | 4 | 24 | 7 | 20 | | |
| | | | | | ,, . . . | 4 | 10 | 2 | 8½ | 2 | 6 | | |
| | | | | | Whitings, . . | 1 | 13 | 1 | 11½ | 3 | 11 | | |
| | | | | | ,, . . | 1 | 10 | 1 | 8 | 1 | 6 | | |
| | | | | | Herring, . . | 1 | 7½ | ... | ... | ... | ... | | |
| STATION II. 24th Feb. 12.5 p.m. to 1.55 p.m. | E. 46·0 | 5·6 | 5·2 11 fath. | Surface-net. — *Parathemisto*, sp. r.; *Calanus finmarchicus*, f.; *Dias longiremis*, f.; *Oithona spinifrons*, f.; Ctenophora (small), r. Bottom-net. — *Hyperia*, sp. f.; *Calanus finmar-* | Thornback ray, . | 1 | 13 | ... | ... | ... | ... | *Buccinum undatum*, several; *Fusus antiquus*, f.; dead shells of *Cyprina Islandica*, several; *Asterias*, sp. f.; *Solaster papposa*, f.; *Cribella oculata*, f.; *Ophiothrix rosula*, | At beginning—Wind calm, force 0; weather, thick fog; sea, smooth; tide, about ½ flood; barometer, 30·30; transparency, 3 fathoms. At finish—Wind, |
| | | | | | Starry ray, . . | 1 | 11 | 1 | 10 | ... | ... | | |
| | | | | | Plaice, . . | 3 | 15 | 12 | 13½ | 12 | 11½ | | |
| | | | | | ,, . . | 10 | 10 | ... | ... | ... | ... | | |
| | | | | | Lemon soles, . | 1 | 15 | 1 | 9½ | ... | ... | | |
| | | | | | Common dabs, . | 3 | 9 | 4 | 8 | 7 | 6½ | | |
| | W. 52·0 | 5·3 | 5·7 13 fath. | | ,, ,, . | 3 | 5 | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 1 | 8 | 4 | 6½ | ... | ... | | |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1891.—I. FIRTH OF FORTH—*continued.*

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Temperature. Water. Surface. | Temperature. Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c., brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION II. 12th Feb. 12.5 p.m. to 1.55 p.m. —*continued.* | | | | *chicus*, fr.; *Dias longiremis*, fr.; *Temora longicornis*, f.; *Alteutha depressa*, r.; *Sagitta*, sp. f.; young Schizopoda, fr. | Cod, | 1 | 27 | ... | ... | ... | ... | c.; *Echinus esculentus*, f.; *Actinoloba dianthus*, f.; *Alcyonium*, sp., several; *Hemiacidon*, sp., several; some weed. | weather, sea, as before; tide, fully ¾ flood; barometer, 30·28; transparency, 3 fathoms. |
| | | | | | Angler, | 1 | 31 | 1 | 14 | ... | .. | | |
| | | | | | Cat-fish, | 1 | 28 | 2 | 33 | 2 | 30 | | |
| STATION III. 18th Feb. 10.30 a.m. to 12.55 p.m. | W. 45·0 | 5·3 | 5·3 9 fath. | Surface-net. — *Calanus finmarchicus*, fr.; *Temora longicornis*, fr.; *Dias longiremis*, f.; *Hyperia* sp. r.; *Parathemisto*, sp. fr.; *Boreophausia*, sp. f.; *Sagitta*, sp. f. | Thornback ray, | 1 | 20 | ... | ... | ... | ... | *Asterias*, sp. r.; *Echinus esculentus*, r.; *Solaster papposa*, f.; *Ophiothrix rosula*, f.; *Nephrops norvegicus*, f.; *Eupagurus bernhardus*, f.; *Portunus depurator*, f.; *Pecten opercularis*, a.; *Actinoloba dianthus*, f.; *Alcyonium*, sp. f. | At beginning—Wind W., force 3; weather, hazy; sea, slight; barometer, 30·50; transparency, 3 fathoms. At finish—Wind, weather, sea, as before; barometer, 30·31; transparency, 3½ fathoms. |
| | | | | | Starry ray, | 1 | 9 | ... | ... | ... | ... | | |
| | | | | | Plaice, | 2 | 14 | 4 | 13 | ... | ... | | |
| | | | | | Lemon soles, | 2 | 12 | 2 | 9 | 2 | 8 | | |
| | | | | | ,, ,, | 1 | 7 | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 1 | 10 | 10 | 8½ | 14 | 7 | | |
| | | | | | ,, ,, | 13 | 5½ | ... | ... | ... | ... | | |
| | E. 45·0 | 5·3 | 5·1 10 fath. | Bottom-net. — *Calanus finmarchicus*, f.; *Caligus*, sp. f.; *Dias longiremis*, f.; *Atolytus*, sp.; (annelids) 1; very little in the net. | Long rough dabs, | 2 | 10 | 11 | 8½ | 3 | 6½ | | |
| | | | | | ,, ,, | 5 | 5½ | ... | ... | ... | ... | | |
| | | | | | Cod, | 1 | 30 | 1 | 24 | 4 | 22 | | |
| | | | | | ,, | 3 | 19 | 2 | 6 | 3 | 8½ | | |
| | | | | | ,, | 4 | 6½ | 4 | 5½ | ... | ... | | |
| | | | | | Whiting, | 2 | 5 | ... | ... | ... | ... | | |
| | | | | | Angler, | 1 | 28 | 1 | 17 | 4 | 12 | | |
| | | | | | Cat-fish, | 1 | 30 | ... | ... | ... | ... | | |
| | | | | | Herring, | 1 | 6 | ... | ... | ... | ... | | |
| STATION IV. 17th Feb. 10.10 a.m. to 12.50 p.m. | E. 45·5 | 5·2 | 5·0 5 fath. | Surface-net. — *Calanus finmarchicus*, f.; *Temora longicornis*, f.; *Dias longiremis*, fr.; *Oithona*, sp. f.; *Boreophausia*, sp. f.; *Hyperia*, sp. r.; *Parathe-* | Plaice, | 1 | 17 | 7 | 15 | 45 | 13½ | *Echinus esculentus*, 1; *Hyas coarctatus*, 1; *Stenorhynchus rostratus*, f.; *Fusus antiquus*, 1; *Buccinum un-* | At beginning—Wind W.S.W., force 4; weather, hazy; sea, smooth; tide, first of ebb; barometer, 30·49; transparency, 2¼ fathoms. |
| | | | | | ,, | 44 | 12 | 45 | 10½ | 8 | 8½ | | |
| | | | | | ,, | 1 | 6 | ... | ... | ... | ... | | |
| | | | | | Lemon sole, | 1 | 9 | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 1 | 11 | 1 | 7½ | ... | ... | | |
| | | | | | Flounders, | 2 | 11 | ... | ... | ... | ... | | |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1891 —I FIRTH OF FORTH—*continued.*

| Station, Date, and Time Trawl down. | Temperature. | | | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. | | | | | | Invertebrate, Fauna, &c., brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Air. | Water. | | | | | | | | | | | |
| | Dry Bulb. | Surface. | Bottom. | | | No. | Inches | No. | Inches | No. | Inches | | |
| STATION IV. 17th Feb. 10.10 a.m. to 12.50 p.m. *continued.* | W. 46·4 | 5·8 | 5·1 4½ fath. | *misto*, sp. f.; *Sagitta*, sp. f. Bottom-net. — *Calanus finmarchicus*, f.; *Parathemisto*, sp. f.; *Sagitta*, sp. f.; *Beröe*, sp. fr. | | | | | | | | *datum*, f.; *Asterias violacea*, f.; *Actinoloba dianthus*, f.; *Hemiacidon*, sp. 1; a few fragments of *Chalina*, sp. | At finish — Wind, weather, sea, as before, tide, fully ½ ebb; barometer, 30·5''; transparency, 2½ fathoms. |
| STATION V. 20th Feb. 10.45 a.m. to 12.45 p.m. | E. 41·0 | 5·8 | 5·7 22 fath. | Surface-net. — *Calanus finmarchicus*, f.; *Dias longiremis*, c.; *Caligus*, sp. f.; *Parathemisto*, sp. fr.; Infusoria (*Ceratium* sp.), fr. | Plaice, | 1 | 16 | 8 | 14 | ... | ... | *Asterias*, sp. f.; *Solaster papposa*, *Nephrops norvegicus*, a small quantity of weed. | At beginning—Wind E., force 1; weather, fog; sea, smooth; tide, about 4 hours flood; barometer, 38·28; transparency, 6 fathoms. At finish—Wind E., force 1; weather, fog; sea, smooth; tide, about high water; barometer, 20·27; transparency, 6 fathoms. |
| | | | | | Lemon soles, | 1 | 12 | 2 | 10 | 2 | 9 | | |
| | | | | | " " | 1 | 8 | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 10 | 9 | 6 | 8 | 4 | 6 | | |
| | | | | | " " | 2 | 5 | ... | ... | ... | ... | | |
| | | | | | Witch soles, | 1 | 16 | ... | ... | ... | ... | | |
| | W. 50·0 | 5·5 | 5·5 24½ fath. | Bottom-net. — *Caligus*, sp. r.; *Calanus finmarchicus*, r.; *Parathemisto*, sp. r.; *Hyperia*, sp. r.; *Beröe*, sp. fr.; Infusoria, fr. | Long rough dabs, | 3 | 12 | 32 | 8½ | 17 | 7 | | |
| | | | | | " " | 5 | 5 | ... | ... | ... | ... | | |
| | | | | | Haddocks, | 4 | 11 | 2 | 8 | ... | ... | | |
| | | | | | Cod, | 1 | 31 | 3 | 25 | 7 | 22 | | |
| | | | | | " | 4 | 17 | 6 | 14 | 8 | 12 | | |
| | | | | | " | 10 | 10 | 13 | 8½ | ... | ... | | |
| | | | | | Whitings, | 1 | 18 | 3 | 14 | 3 | 12 | | |
| | | | | | " | 7 | 8½ | 7 | 7 | 1 | 5½ | | |
| | | | | | Angler, | 2 | 28 | 1 | 22 | ... | ... | | |
| | | | | | Cat-fish, | 1 | 38 | 2 | 3 | 2 | 23 | | |
| | | | | | *Lumpenus lampetriformis*, | 1 | 9 | ½ | ... | ... | ... | | |
| STATION VI. 20th Feb. 1.25 p.m. to 2.15. p.m. | E. 45·0 | 5·5 | 5·4 14 fath. | Surface-net.—*Calanus finmarchicus*, f.; *Temora longicornis*, f.; *Dias longiremis*, c.; *Oithona spinifrons*, f.; In- | Plaice, | 2 | 16½ | 2 | 14½ | 1 | 8 | *Solaster papposa*, 1; *Asterias*, sp. f.; *Nephrops norvegicus*, f. | At beginning—Wind E., force 2; weather, fog; sea, smooth; tide, first of ebb; barometer, |
| | | | | | Lemon soles, | 1 | 15 | 4 | 12½ | 1 | 10 | | |
| | | | | | " " | 1 | 8 | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 5 | 8 | 2 | 5 | ... | ... | | |

TABLE C.—Record of Observations made on Board the 'Garland' during 1891.—I. Firth of Forth—*continued.*

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Water. Surface. | Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c., brought up in Trawl Net. | Wind Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station VI. 20th Feb. 1.25 p.m. to 2.15 p.m.—*continued.* | W. 44·9 | 5·6 | 6·0 13 fath. | fusoria (*Ceratium*, sp.); Diatomacea, fr. Bottom-net.—*Calanus finmarchicus*, f.; *Dias longiremis*, r.; *Parathemisto*, sp. r.; *Atylus bispinosus*, sp. f.; *Sagitta*, sp. f.; *Tomopteris*, sp. f.; larval Schizopods, f. | Long rough dabs, | 1 | 9 | 1 | 8 | 3 | 7 | | 30·25; transparency, 5¼ fathoms. At finish—Wind E., force 3; weather, fog; sea, slight; tide, first ¼ ebb; barometer, 5½ fathoms. |
| | | | | | Cod, | 1 | 20 | 1 | 16 | ... | ... | | |
| Station VII. 20th Feb. 8.0 a.m. to 9.30 p.m. | W. 36·8 | 5·1 | 5·1 9 fath. | Surface-net.—*Dias longiremis*, f.; *Parathemisto*, ab.; *Idotea marina*, 1; Infusoria, c. (*Ceratium*, &c.). Bottom-net. — *Calanus finmarchicus*, f.; *Temora longicornis*, f.; *Dias longiremis*, f.; *Caligus*, sp. f.; *Sagitta*, sp. f.; *Tomopteris*, sp. f. | Plaice, | 1 | 17 | 1 | 15½ | 5 | 13 | Fragments of *Luidia sarsii*; *Asterias*, sp. f.; a little weed. | At beginning — Wind S.W., force 1; weather, hazy; sea, smooth; tide, first ¼ flood; barometer, 30·31; transparency, 3½ fathoms. At finish—Wind W., force 1; weather, thick fog; sea, smooth; tide, ½ flood; barometer, 30·30; transparency, 4 fathoms. |
| | | | | | ,, | 1 | 6 | ... | ... | ... | ... | | |
| | | | | | Common dab, | 3 | 9 | 9 | 7½ | 6 | 6½ | | |
| | | | | | ,, ,, | 4 | 5½ | ... | ... | ... | ... | | |
| | E. 40·4 | 5·1 | 5·2 20 fath. | | Witch sole, | 1 | 18 | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 1 | 8 | 4 | 7 | 1 | 6 | | |
| | | | | | ,, ,, | 3 | 5½ | ... | ... | ... | ... | | |
| | | | | | Haddocks, | 1 | 11 | 1 | 9 | ... | ... | | |
| | | | | | Cod, | 1 | 5 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 2 | 8 | 1 | 7 | 2 | 6 | | |
| | | | | | ,, | 1 | 5½ | ... | ... | ... | ... | | |
| | | | | | Anglers, | 1 | 15 | ... | ... | ... | ... | | |
| | | | | | Cat-fish, | 1 | 40 | ... | ... | ... | ... | | |
| | | | | | Pogge, | 2 | 4½ | ... | ... | ... | ... | | |
| Station VIII. 19th Feb. 12. noon to 2.0 p.m. | S.W. 49·9 | 5·8 | 5·5 21 fath. | Surface-net. — *Calanus finmarchicus*, f.; *Temora longicornis*, f.; *Dias longiremis*, f.; *Centropages*, sp. f.; *Parathemisto*, f.; *Sagitta*, sp. f.; fish-ova, f. | Thornback ray, | 1 | 19 | ... | ... | ... | ... | *Asterias*, sp. r.; *Solaster papposa*, 1; *Nephrops norvegicus*, r.; *Pandalus annulicornis*, 1; | At beginning — Wind calm, force 0; weather, very hazy; sea, smooth, tide, high water; barometer, 30·41; transparency, 4 fathoms. |
| | | | | | Common dabs, | 2 | 9 | 5 | 7½ | 6 | 6 | | |
| | | | | | Long rough dabs, | 2 | 10 | 16 | 8½ | 13 | 6½ | | |
| | | | | | ,, ,, | 6 | 5 | ... | ... | ... | ... | | |
| | | | | | Sail fluke, | 1 | 18 | ... | ... | ... | ... | | |
| | | | | | Haddock, | 8 | 11 | 2 | 9 | 1 | 7½ | | |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1891.—I. FIRTH OF FORTH—*continued.*

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Water. Surface. | Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c., brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION VIII. 19th Feb. 12 noon to 2.0 p.m.—*continued.* | N.E. 45·3 | 5·7 | 5·8 27 fath. | Bottom-net. — *Calanus finmarchicus*, f.; *Dias longiremis*, f.; *Caligus*, sp. r.; *Parathemisto*, sp. r.; *Cuma*, sp. (?) 1; *Sagitta*, sp. r.; *Tomopteris*, sp. f. | Cod, . . . | 2 | 22 | ... | ... | ... | ... | *Buccinum undatum*, 1; *Actinoloba dianthus*, r. | At finish—Wind S.E., force 2; weather, clear, hazy round horizon; sea as before; tide, 2 hours ebb; barometer, 30·37; transparency, 5 fathoms. |
| | | | | | Whiting, . . | 1 | 13 | 1 | 9 | 3 | 8 | | |
| | | | | | ,, . . . | 1 | 10 | 2 | 5½ | 1 | 6 | | |
| | | | | | ,, . . . | 1 | 5 | ... | ... | ... | ... | | |
| STATION IX. 19th Feb. 2.30 p.m. to 4.15 p.m. | N.W. 47·0 | 5·8 | 5·7 27 fath. | Surface-net. — *Calanus finmarchicus*, f.; *Temora longicornis*, f.; *Dias longiremis*, f.; *Centropages*, sp. f.; *Parathemisto*, sp. f.; *Sagitta*, sp. f.; fish-ova, f.; Infusoria, fr. | Grey skate, . . | 1 | 11 | ... | ... | ... | ... | Little or nothing in Trawl net other than the fish. | At beginning — Wind S.E., force 3; weather, clear, hazy round horizon; sea, smooth; tide, near ¼ ebb; barometer, 30·37; transparency, 5 fathoms. At finish—Wind calm, force 0; tide, near ¾ ebb; barometer, 30·35; transparency, 6½ fathoms. |
| | | | | | Plaice, . . | 1 | 17 | ... | ... | ... | ... | | |
| | | | | | Lemon soles, . | 1 | 6 | ... | ... | ... | ... | | |
| | | | | | Common dabs, . | 3 | 9 | 7 | 7½ | 12 | 6 | | |
| | | | | | Long rough dabs, | 2 | 9 | 6 | 7½ | 2 | 3 | | |
| | | | | | Haddocks, . . | 1 | 20 | 1 | 13 | 1 | 11 | | |
| | | | | | Cod, . . . | 1 | 9 | ... | ... | ... | ... | | |
| | S.E. 44·5 | 5·7 | 5·5 32 fath. | Bottom-net. — *Calanus finmarchicus*, f.; *Dias longiremis*, f.; *Candace pectinata*, f.; *Caligus*, sp. r.; *Parathemisto*, sp. r.; *Pseudocuma*, sp. r.; *Sagitta*, sp. r.; *Tomopteris*, sp. f. | Whitings, . . | 4 | 8 | 1 | 6 | 1 | 5½ | | |
| | | | | | Common gurnard, | 1 | 10 | ... | ... | ... | ... | | |
| | | | | | Angler, . . | 1 | 14 | ... | ... | ... | ... | | |
| STATION I. 18th March 10.35 a.m. to 1.25 p.m | W. 39·0 | 4·5 | 5·3 9 fath. | Surface-net. — *Parathemisto*, r.; *Calanus finmarchicus*, r.; larval *Balani*, Infusoria (*Ceratium*), Diatoms, com. Bottom-net. — *Crangon* | Grey skate, . | 1 | 16 | 8 | 13 | 1 | 7 | *Buccinum undatum*, several; *Nephrops norvegicus*, f.; *As-* | At beginning — Wind W., force 2; weather, very hazy; sea, strong E. swell; |
| | | | | | Starry ray, . . | 1 | 10 | ... | ... | ... | ... | | |
| | | | | | Thornback ray, . | 4 | 4 | 2 | 15 | ... | ... | | |
| | | | | | Plaice, . . | 3 | 14 | 5 | 12 | ... | ... | | |

TABLE C.—Record of Observations made on Board the 'Garland' during 1890.—I. Firth of Forth—*continued*.

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Temperature. Water. Surface. | Temperature. Water. Bottom. | Pelagic Fauna, Spawn and young fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station I. 13th March 10.35 a.m. to 1.25 p.m. —*continued*. | E. 44·0 | 5·3 | 4·7 19 fath. | *manus*, f.; *Mysis ornatus*, f.; *Mysis spiritus*, f.; *Leptomysis*, sp. r.; *Mysidopsis gibbosa*, f.; *Mysidopsis didelphys*, r.; *Mysidopsis augusta*, r.; *Erythrops goesii*, f.; *Boreophausia*, sp. fr.; *Diastylis*, sp. f.; *Parathemisto*, sp. fr.; *Atylus bispinosus*, f.; *Calanus finmarchicus*, fr.; *Pseudocalanus*, sp. f.; *Dias longiremis*, f.; *Temora longicornis*, f.; *Oithona*, sp. f.; *Alteutha depressa*, f.; *Sagitta*, sp. c. | Lemon soles, . | 4 | 15 | 7 | 11½ | 1 | 9 | *erias*, sp. f.; *Solaster papposa*, r.; *Actinoloba dianthus*, f.; some weed. | tide, low water; barometer, 29·90; transparency, 2 fathoms. At finish—Wind calm, force 0; sea, smooth; weather, a little hazy; tide, about ½ flood; transparency, 3 fathoms. |
| | | | | | ,, ,, . | 2 | 7 | ... | ... | ... | ... | | |
| | | | | | Common dabs, . | 4 | 9 | 11 | 7 | 6 | 6 | | |
| | | | | | Flounders, . . | 1 | 13 | 1 | 11 | 1 | 9 | | |
| | | | | | Long rough dabs, | 1 | 10 | 4 | 8½ | 4 | 6 | | |
| | | | | | Haddock, . . | 1 | 11 | ... | ... | ... | ... | | |
| | | | | | Cod, . . . | 1 | 32 | 5 | 26 | 4 | 17 | | |
| | | | | | ,, . . . | 13 | 10½ | 12 | 9 | 2 | 6 | | |
| | | | | | Whitings, . . | 4 | 12 | 4 | 10 | 7 | 8½ | | |
| | | | | | ,, . . . | 3 | 6 | ... | ... | ... | ... | | |
| | | | | | Angler, . . | 1 | 31 | 1 | 22 | 7 | 15 | | |
| | | | | | ,, . . . | 3 | 11 | ... | ... | ... | ... | | |
| | | | | | Herring, . . | 1 | 7 | ... | ... | ... | ... | | |
| Station II. 13th March 2.10 p.m. to 3.35 p.m. | E. 51·0 | 5·2 | 4·8 14 fath. | Surface-net. — *Parathemisto*, sp. f.; *Calanus finmarchicus*, f.; *Temora longicornis*, f.; *Sagitta*, sp. f.; Infusoria, fr. Bottom-net. — *Parathemisto*, sp. fr.; *Atylus bispinosus*, f.; *Stenothöe marina*, f.; *Calanus finmarchicus*, fr.; *Dias longiremis*, fr.; *Temora longicornis*, fr.; *Sagitta*, sp. c.; larval Schizopoda, fr.; larval *Balani*, fr. | Plaice, . . | 1 | 18 | 4 | 15 | 26 | 13½ | *Ascidia*, sp. c.; *Chiton*, f.; *Asterias*, sp. fr.; *Solaster papposa*, f.; *Solaster endeca*, r.; *Ophiothrix rosula*, c.; *Alcyonium*, sp. c. | At beginning — Wind calm, force 0; weather, a slight haze, fine; sea, smooth; tide, fully ½ flood; barometer, 29·89; transparency, 2¾ fathoms. At finish—Wind variable, force 1; tide, 5 hours flood; transparency, 2½ fathoms. |
| | | | | | ,, . . . | 10 | 10 | ... | ... | ... | ... | | |
| | | | | | Lemon soles, . | 2 | 13½ | 1 | 11 | 2 | 7½ | | |
| | | | | | ,, ,, . | 1 | 4½ | ... | ... | ... | ... | | |
| | W. 55·0 | 5·0 | 4·8 13½ fath. | | Common dabs, . | 1 | 11 | 10 | 8½ | 9 | 6½ | | |
| | | | | | ,, ,, . | 2 | 5 | ... | ... | ... | ... | | |
| | | | | | Flounders, . . | 4 | 11½ | 3 | 9½ | 3 | 8 | | |
| | | | | | ,, . . . | 1 | 15 | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 2 | 7 | 1 | 6½ | 1 | 5½ | | |
| | | | | | Cod, . . . | 1 | 20 | 1 | 14 | 2 | 9½ | | |
| | | | | | ,, . . . | 2 | 7 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, . | 1 | 4 | ... | ... | ... | ... | | |
| | | | | | Angler, . . | 1 | 7 | ... | ... | ... | ... | | |
| | | | | | Cat-fish, . . | 1 | 24 | ... | ... | ... | ... | | |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1891.—I. FIRTH OF FORTH—*continued.*

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Temperature. Water. Surface. | Temperature. Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION III. 14th March 11.30 a.m. to 2.0 p.m. | E. 43·0 | 5·0 | 5·0 11 fath. | | Starry ray, | 1 | 9 | ... | ... | ... | ... | *Pecten opercularis*, fr.; *Mytilus modiolus*, several; *Hyas araneus*, f.; *Nephrops norvegicus*, f.; *Aphrodite*, sp. r.; *Echinus*, sp. several; *Asterias*, sp. several; *Actinoloba*, sp. f.; and a little weed. | At beginning — Calm and dull, hazy; sea, smooth; tide, nearly low water; barometer, 29·87; transparency, 2 fathoms. At finish—Calm and fine, clear; sea, smooth; tide, about 2½ hours flood; barometer, 29·83; transparency, 2½ fathoms. |
| | | | | | Thornback ray, | 1 | 18 | 1 | 6 | ... | ... | | |
| | | | | | Plaice, | 5 | 14 | 8 | 12 | 4 | 9 | | |
| | | | | | Lemon soles, | 8 | 14 | 2 | 13 | 8 | 11 | | |
| | | | | | ,, ,, | 9 | 9 | 6 | 7 | 8 | 6 | | |
| | W. 43·0 | 4·9 | 4·6 8 fath. | | Common dabs, | 2 | 10 | 8 | 7 | 2 | 6 | | |
| | | | | | Long rough dabs, | 2 | 9 | 2 | 7 | ... | ... | | |
| | | | | | Cod, | 1 | 39 | 1 | 26 | 2 | 24 | | |
| | | | | | ,, | 7 | 20 | 8 | 15 | 12 | 10 | | |
| | | | | | ,, | 1 | 7 | 1 | 5 | 4 | 6 | | |
| | | | | | Whitings, | 1 | 11 | 12 | 10 | 18 | 9 | | |
| | | | | | ,, | 16 | 8 | 6 | 6 | 1 | 5 | | |
| | | | | | Angler, | 3 | 15 | 1 | 7 | ... | ... | | |
| | | | | | Pogge, | 1 | 5½ | ... | ... | ... | ... | | |
| STATION IV. 18th March 10.35 a.m. to 2.25 p.m. | W. 39·0 | 4·5 | 4·2 4½ fath. | Surface-net — *Parathemisto*, sp. c.; *Gammarus*, sp. f.; *Idotea marina*, r.; *Calanus finmarchicus*, f.; *Dias longiremis*, f.; *Temora longicornis*, f. Bottom-net. — *Boreophausia*, sp. f.; *Mysis ornatus*, r.; *Parathemisto*, sp. fr.; *Atylus*, sp. f.; *Ampelisca*, sp. f.; *Calanus finmarchicus*, fr.; *Temora longicornis*, c.; *Centropages*, sp. r.; *Sagitta*, sp. c.; *Tomopteris*, sp. f. | Starry ray, | 2 | 12 | ... | ... | ... | ... | *Pecten opercularis*, c.; *Mytilus modiolus*, several; *Fusus antiquus*, several; *Buccinum undatum*, several; *Ascidians*, f.; *Doris*, f.; *Stenorhynchus*, f.; *Hyas coarctatus*, r.; *Hyas araneus*, f.; *Portunus holsatus*, fr.; *Portunus depurator*, ff.; *Pinnotheres pisum* (in horse | At beginning — Wind E. by N.; force 4; weather, dull; sea, moderate; tide, 2 hours ebb; barometer, 30·06; transparency, 1 fathom. At finish—Wind E.N.E.; force 3; tide, about low water; transparency, 2 fathoms. |
| | | | | | Plaice, | 7 | 16 | 17 | 14 | 81 | 12 | | |
| | | | | | ,, | 21 | 10 | 18 | 9 | ... | ... | | |
| | | | | | Lemon soles, | 2 | 12 | 1 | 10 | 2 | 9 | | |
| | | | | | ,, ,, | 1 | 7 | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 4 | 10 | 8 | 8 | 14 | 7 | | |
| | E. 45·0 | 4·8 | 4·3 5 fath. | | ,, ,, | 2 | 6 | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 1 | 11 | 1 | 8 | 1 | 7 | | |
| | | | | | Cod, | 4 | 21 | 3 | 16 | 12 | 11½ | | |
| | | | | | ,, | 5 | 9 | 2 | 6 | ... | ... | | |
| | | | | | Whitings, | 1 | 9 | ... | ... | ... | ... | | |

TABLE C.—Record of Observations made on Board the 'Garland during 1891.—I. Firth of Forth—*continued.*

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Water. Surface. | Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c., brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station IV. 18th March 10.35 a.m. to 2.25 p.m. —*continued.* | | | | | | | | | | | | mussel) f.; *Porcellana longicornis*, fr.; *Aphrodite*, sp. r.; *Polynöe*, sp. r.; *Lineus marinus* (a large specimen 45 feet long); *Asterias*, sp. fr.; *Solaster papposa*, f.; *Ophiothrix rosula*, f.; *Echinus miliaris*, r.; *Alcyonium*, sp. f.; some weed. | |
| Station V. 19th March 1.50 p.m. to 4.20 p.m. | W. 40·0 | 4·8 | 5·0 25 fath. | Surface-net. — *Parathemisto*, sp. f.; *Calanus finmarchicus*, f.; *Dias longiremis*, f.; *Temora longicornus*, f.; *Centropages*, sp. r.; *Sagitta*, sp. f.; larval *Balani*, fr.; fish-ova, fr. Bottom-net.—*Crangon allmanni*, f.; *Crangon nanus*, f.; *Pandalus brevirostris* (with ova) r.; *Mysis*, sp. fr.; *Siriella*, sp. r.; *Mysidopsis didelphys*, r.; *Leptomysis*, sp. f.; *Erythrops goesii*, c.; *Parathemisto*, sp. f.; *Diastylis, rugas*, c.; *Atylus bispinosus* fr.; *Monoculodes longimanus*, f.; *Calanus finmarchicus*, fr.; *Dias longiremis*, f.; *Temora longicornis*, fr.; *Candace pectinata*, f.; *Sagitta*, sp. c. | Grey skate, | 1 | 16 | ... | ... | ... | ... | A considerable number of Cray-fish (*Nephrops norvegicus*) but scarcely anything else. | At beginning — Wind N.N.E., force 5; weather, overcast; sea, rough; tide, 4 hours ebb; barometer, 29·98; transparency, 2 fathoms. At finish — Weather, improving; sea, rough; tide, low water; barometer, 29·93; transparency, 3 fathoms. |
| | | | | | Thornback ray, | 1 | 27 | ... | ... | ... | ... | | |
| | | | | | Plaice, | 4 | 15 | 14 | 13 | 3 | 12 | | |
| | | | | | Lemon soles, | 1 | 16 | 3 | 13 | 1 | 10 | | |
| | | | | | " " | 1 | 8 | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 1 | 10 | 5 | 8 | 1 | 5 | | |
| | E. 40·6 | 4·7 | 4·6 20 fath. | | Witch soles, | 1 | 19 | 3 | 8 | 2 | 16 | | |
| | | | | | Long rough dabs, | 2 | 13 | 16 | 9 | 21 | 7 | | |
| | | | | | " " | 2 | 6 | ... | ... | ... | ... | | |
| | | | | | Haddocks, | 17 | 12 | 2 | 10 | 2 | 7 | | |
| | | | | | Cod, | 1 | 37 | 4 | 28 | 10 | 25 | | |
| | | | | | " | 6 | 22 | 4 | 17 | 5 | 12 | | |
| | | | | | " | 10 | 9 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 2 | 18 | 1 | 17 | 2 | 15 | | |
| | | | | | " | 6 | 13 | 5 | 11 | 15 | 8 | | |
| | | | | | Com. gurnards, | 1 | 12 | ... | ... | ... | ... | | |
| | | | | | *Trigla hirundo*, | 1 | 12 | ... | ... | ... | ... | | |
| | | | | | Angler, | 1 | 29 | 5 | 14 | ... | ... | | |

TABLE C.—Record of Observations made on Board the 'Garland' during 1891.—I. Firth of Forth—*continued.*

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Temperature. Water. Surface. | Temperature. Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c., brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station VI. 21st March 12.10 p.m. to 1.0 p.m. | E. 41·0<br>W. 41·0 | 4·9<br>4·7 | 4·5 15½ fath.<br>4·4 14½ fath. | Surface-net. — Very little except larval *Balani*, *Temora longicornis*, f.; *Dias longiremis*, f.; larval *Balani*, c.; fish-ova, f. Bottom-net.—*Erythrops göesii*, r.; *Parathemisto*, sp. r.; *Atylus bispinosus*, f.; *Calanus finmarchicus*, f.; *Temora longicornis*, fr.; *Sagitta*, sp. fr. | Plaice, | 3 | 21 | 6 | 17 | 26 | 14 | Very little *Asterias*, sp. f.; *Solaster papposa*, r.; *Solaster endeca*, r.; *Echinus esculentus*, 2; *Nephrops norvegicus*, f. | At beginning — Wind E.N.E., force 2; weather, overcast; sea, easterly swell; barometer, 29·93; transparency, 2⅝ fathoms. At finish—Wind weather, sea, as before; barometer, 29·93; transparency, 2⅓ fathoms. |
| | | | | | " | 31 | 12 | 3 | 10 | 1 | 7 | | |
| | | | | | Lemon soles, | 3 | 14 | 8 | 12 | 2 | 10 | | |
| | | | | | " " | 5 | 8½ | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 1 | 11 | 4 | 10 | 6 | 8½ | | |
| | | | | | " " | 10 | 7 | ... | ... | ... | ... | | |
| | | | | | Flounders, | 2 | 9 | 1 | 8 | ... | ... | | |
| | | | | | Long rough dabs, | 1 | 6 | ... | ... | ... | ... | | |
| | | | | | Brill, | 1 | 22 | ... | ... | ... | ... | | |
| | | | | | Haddocks, | 1 | 10 | ... | ... | ... | ... | | |
| | | | | | Cod, | 1 | 29 | 1 | 23 | 1 | 19 | | |
| | | | | | " | 9 | 17 | 4 | 14 | 4 | 11 | | |
| | | | | | " | 2 | 8 | 3 | 5½ | ... | ... | | |
| | | | | | Whitings, | 2 | 9 | ... | ... | ... | ... | | |
| | | | | | Com. Gurnard, | 1 | 13 | ... | ... | ... | ... | | |
| | | | | | Angler, | 1 | 20 | ... | ... | ... | ... | | |
| | | | | | Cat-fish, | 1 | 34 | 2 | 29 | ... | ... | | |
| Station VII. 19th March 11.15 a.m. to 1.0 p.m. | W. 39·0<br>E. 40·0 | 4·9<br>4·8 | 4·8 11 fath.<br>4·5 18 fath. | Surface-net. — *Parathemisto*, sp. r.; *Calanus finmarchicus*, f.; *Dias longiremis*, f.; *Temora longicornis*, f.; *Sagitta*, sp. f.; larval *Balani*, f. Bottom-net. — *Crangon manus*, f.; *Hippolyte fascigera*, f.; *Boreo phausia*, sp. fr.; *Mysis ornatus*, f.; *Mysis lamorne*, f.; *Mysis spiritus*, f.; *Mysidopsis augusta*, r., *Erythrops*, sp. fr.; *Diastylus*, | Grey skate, | 1 | 10 | 1 | 9 | ... | ... | Very little. *Buccinum undatum*, r.; *Hyas araneus*, r.; *Asterias*, sp. f.; *Echinus esculentus*, r.; *Alcyonium*, sp. r. | At beginning — Wind N.N.E., force 4; weather, overcast; sea, rough; tide, first ¼ ebb; barometer, 29·95; transparency, 3 fathoms. At finish—Wind, weather, sea, as before; tide, ½ ebb; |
| | | | | | Starry ray, | 1 | 13 | 1 | 9 | 2 | 5½ | | |
| | | | | | " " | 1 | 8½ | ... | ... | ... | ... | | |
| | | | | | Thornback ray, | 1 | 14 | 1 | 11 | ... | ... | | |
| | | | | | Plaice, | 1 | 17 | 1 | 12 | 2 | 9 | | |
| | | | | | Lemon soles, | 1 | 8 | 1 | 7 | ... | ... | | |
| | | | | | Common dabs, | 1 | 9 | 10 | 7 | 1 | 6 | | |
| | | | | | " " | 2 | 5 | ... | ... | ... | ... | | |
| | | | | | Flounders, | 1 | 13 | 1 | 12 | 1 | 9 | | |
| | | | | | " | 1 | 7 | ... | ... | ... | ... | | |
| | | | | | Witch soles, | 1 | 17 | ... | ... | ... | ... | | |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1891.—I. FIRTH OF FORTH—*continued.*

| Station, Date, and Time Trawl down. | Temperature. | | | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. | | | | | | Invertebrate Fauna, &c., brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Air. | Water. | | | | | | | | | | | |
| | Dry Bulb. | Surface. | Bottom. | | | No. | Inches | No. | Inches | No. | Inches | | |
| STATION VII. 19th March 11.15 a.m. to 1.0 p.m. —*continued.* | | | | sp. f.; *Cuma*, sp. r.; *Parathemisto*, sp. fr.; *Atylus bispinosus*, f.; *Atylus swammerdami*, f.; *Ilphimedia obesa*, r.; *Calanus finmarchicus*, fr.; *Dias longiremis*, f.; *Temora longicornis*, fr.; *Sagitta*, sp. fr.; young ling (*Molva vulgaris*), rare. | Long rough dabs, | 2 | 7 | ... | ... | ... | ... | | barometer, 29·97; transparency, 2½ fathoms. |
| | | | | | Haddocks, | 10 | 11 | 1 | 9 | ... | ... | | |
| | | | | | Cod, | 1 | 22 | 3 | 11 | 1 | 9 | | |
| | | | | | " | 1 | 7 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 2 | 11½ | 8 | 9 | 4 | 8 | | |
| | | | | | " | 2 | 5½ | ... | ... | ... | ... | | |
| STATION I. 15th April 10·43 a.m. to 12·43 p.m | W. 46·8 | 5·1 | 5·0 18 fath. | Surface-net.—*Parathemisto*, sp. f.; *Idotea marina*, r.; *Boreophausia*, sp. r.; *Calanus finmarchicus*, f.; *Dias longiremis*, f.; *Temora longicornis*, f.; *Sagitta*, sp. r.; larval *Balani*, fr.; fish-ova, f. | Thornback rays, | 1 | 21 | 1 | 19 | 1 | 17 | *Pecten opercularis*, f.; *Mytilus modiolus*, f.; *Buccinum undatum*, r.; *Fusus antiquus*, r.; *Nephrops norvegicus*, r.; *Solaster papposa*, r.; *Asterias*, sp. r.; *Actinoloba*, sp. r.; *Alcyonium*, sp. r.; very little in net. | At beginning — Wind W., force 3; weather, hazy; sea, slight; tide, fully ½ ebb; barometer, 30·3; transparency, 2 fathoms. At finish—Wind W., force 4; sea, slight; tide, nearly low water; barometer, 30·04; transparency, 2⅜ fathoms. |
| | | | | | " " | 2 | 13 | ... | ... | ... | ... | | |
| | | | | | Plaice, | 2 | 13 | 3 | 12 | 2 | 10½ | | |
| | | | | | " | 1 | 7 | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 1 | 12 | 2 | 11 | 18 | 8 | | |
| | | | | | " " | 10 | 6½ | ... | ... | ... | ... | | |
| | | | | | Lemon soles, | 8 | 13 | 4 | 9 | 10 | 7½ | | |
| | | | | | Flounders, | 1 | 10½ | 1 | 8 | ... | ... | | |
| | E. 49·0 | 5·3 | 4·8 15 fath. | Bottom-net.—*Parathemisto*, sp. f.; *Hyperia*, sp. r.; *Calanus finmarchicus*, f.; *Pseudocalanus*, sp. fr.; *Temora longicornis*, fr.; *Sagitta*, sp. f.; larval Schizopoda, f.; larval *Balani*, ab. | Long rough dabs, | 2 | 12 | 12 | 8 | 1 | 10½ | | |
| | | | | | " " | 6 | 6½ | ... | ... | ... | ... | | |
| | | | | | Haddocks, | 3 | 11 | ... | ... | ... | ... | | |
| | | | | | Cod, | 1 | 18 | 3 | 16 | 11 | 13 | | |
| | | | | | " | 7 | 10 | 7 | 7½ | 2 | 5½ | | |
| | | | | | Whitings, | 2 | 16 | 3 | 13 | 8 | 10 | | |
| | | | | | " | 6 | 8½ | 2 | 6½ | ... | ... | | |
| | | | | | Herrings, | 1 | 7½ | 4 | 6½ | 3 | 5 | | |
| | | | | | Anglers, | 1 | 23 | 3 | 17 | 1 | 15 | | |
| | | | | | Cat-fish, | 1 | 37 | 2 | 33 | 1 | 27 | | |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1891.—I. FIRTH OF FORTH—*continued*

| Station, Date, and Time Trawl down. | Temperature. | | | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. | | | | | | Invertebrate Fauna, &c., brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Air. | Water. | | | | | | | | | | | |
| | Dry Bulb. | Surface. | Bottom. | | | No. | Inches | No. | Inches | No. | Inches | | |
| STATION II. 15th April 1.27 p.m. to 3.24 p.m. | E. 46·5 | 5·6 | 4·9 16 fath. | Surface-net. — *Parathemisto*, sp. f.; *Boreophausia*, sp. f.; *Calanus finmarchicus*, f.; *Dias longiremis*, f.; *Temora longicornis*, fr.; *Sagitta*, sp. r.; larval Crustacea (Decapoda, Schizopoda, and *Balani*), fr. | Plaice, | 1 | 16 | 12 | 14½ | 3 | 11 | A few *Pecten opercularis*, *Nephrops norvegicus*, *Echinoderms*, and *Alcyonium*, sp. | At beginning — Wind W.N.W., force 5; weather, becoming overcast; sea, moderate; tide, first of flood; barometer, 30·02; transparency, 3 fathoms. At finish—Wind W.N.W., force 5; weather, cloudy; sea, moderate; tide, fully 2 hours flood; barometer, 30·01; transparency, 3 fathoms. |
| | | | | | " | 1 | 5 | ... | ... | ... | ... | | |
| | | | | | Lemon soles, | 8 | 13 | 1 | 11½ | 1 | 6½ | | |
| | | | | | Common dabs, | 1 | 12 | 4 | 8 | 9 | 10 | | |
| | | | | | " " | 8 | 5½ | ... | ... | ... | ... | | |
| | | | | | Flounders, | 2 | 12 | 1 | 11 | ... | ... | | |
| | | | | | Long rough dabs, | 3 | 9 | 1 | 7 | ... | ... | | |
| | W. 47·0 | 5·3 | 4·8 11 fath. | Bottom-net. — *Parathemisto*, sp. fr.; *Calanus finmarchicus*, f.; *Pseudocalanus elongatus*, fr.; *Temora longicornis*, fr.; *Sagitta*, sp. f.; larval Schizopoda, f.; larval *Balani*, ab. | Cod, | 2 | 22 | 6 | 16 | 1 | 13 | | |
| | | | | | " | 2 | 7 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 1 | 10½ | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, | 1 | 16 | ... | ... | ... | ... | | |
| | | | | | Angler, | 1 | 8 | ... | ... | ... | ... | | |
| | | | | | Cat-fish, | 1 | 24 | 1 | 21 | ... | ... | | |
| STATION III. 4th May 2.30 p.m to 4.30 p.m. | E. 54·0 | 45·5 | 43·0 11 fath. | Surface-net. — *Boreophausia*, sp. r.; *Parathemisto*, sp. fr.; *Calanus finmarchicus*, fr.; *Dias longiremis*, fr.; *Temora longicornis*, f.; *Sagitta*, sp. f.; larval *Balani*, f. | Grey skate, | 1 | 9½ | .. | ... | ... | ... | *Buccinum*, sp. f.; *Pecten opercularis*, f.; *Mytilus modiolus*, f.; *Nephrops norvegicus*, f.; *Asterias*, sp., several; *Actinoloba dianthus*, r. | At beginning — Wind E.N.E., force 3; weather, clear; sea, slight; tide, ½ ebb; barometer, 29·96; transparency, 5½ fathoms. At finish—Wind E., force 1; weather, clear; sea, slight; tide, 5 hours ebb; barometer, 29·99; transparency, 3½ fathoms. |
| | | | | | Thornback ray, | 1 | 26 | .. | ... | ... | ... | | |
| | | | | | Plaice, | 4 | 14 | 5 | 18 | 7 | 10 | | |
| | | | | | " | 4 | 9 | .. | ... | ... | ... | | |
| | | | | | Lemon dabs, | 4 | 14 | 7 | 11 | 15 | 8 | | |
| | W. 54·0 | 45·7 | 42·9 10 fath. | | " " | 1 | 6 | .. | ... | ... | ... | | |
| | | | | | Common dabs, | 1 | 10 | 4 | 9 | 15 | 7 | | |
| | | | | Bottom-net. — *Boreophausia*, sp. f.; *Calanus finmarchicus*, fr.; *Temora longicornis*, f.; *Caligus rapax*, f.; *Sagitta*, sp. fr.; larval *Balani*, fr. | " " | 6 | 5 | ... | ... | ... | ... | | |
| | | | | | Flounders, | 1 | 14 | 1 | 9 | 1 | 7 | | |
| | | | | | Long rough dabs, | 2 | 12 | 9 | 10 | 6 | 7 | | |
| | | | | | " | 8 | 6 | ... | ... | ... | ... | | |
| | | | | | Haddocks, | 1 | 19 | ... | ... | ... | ... | | |
| | | | | | Cod, | 1 | 30 | 1 | 26 | 3 | 21 | | |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1891.—I. FIRTH OF FORTH—*continued.*

| Station, Date, and Time Trawl down. | Temperature. | | | Pelagic Fauna, Spawn, and young Fish. | Description of Take | Number and Size of Fish. | | | | | | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Air. | Water. | | | | | | | | | | | |
| | Dry Bulb. | Surface. | Bottom. | | | No. | Inches | No. | Inches | No. | Inches | | |
| STATION III. 4th May 2.30 p.m. to 4.30 p.m. —*continued.* | | | | | Cod, | 4 | 14 | 20 | 12 | 6 | 8 | | |
| | | | | | Whitings | 1 | 13 | 2 | 12 | 20 | 10 | | |
| | | | | | " | 21 | 8 | ... | ... | ... | ... | | |
| | | | | | Brassie, | 1 | 12 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, | 4 | 13 | 5 | 12 | 17 | 6½ | | |
| | | | | | " " | 7 | 5½ | ... | ... | ... | ... | | |
| | | | | | Cat-fish, | 1 | 36 | 1 | 31 | ... | ... | | |
| | | | | | Anglers, | 1 | 24 | 1 | 17 | 1 | 13 | | |
| STATION IV. 4th May 10.55 a.m. to 1.55 p.m. | W. 54·0 | 46·1 | 44·9 5½ fath. | Surface-net. — *Boreophausia*, sp. r.; *Parathemisto*, sp. r.; *Calanus finmarchicus*, f.; *Dias longiremis*, f.; *Temora longicornis*, f.; larval *Balani*, f. | Thornback ray, | 4 | 20 | 5 | 18 | 3 | 16 | *Buccinum*, sp. f.; *Pecten opercularis*, several; *Nephrops norvegicus*, r.; *Echinus esculentus*, r.; *Asterias*, sp. f.; *Actinoloba dianthus*, r.; and a little weed. | At beginning — Wind E., force 1; weather, clear, fine; sea, smooth; tide, 5 hours flood; barometer, 29·89; transparency, 3 fathoms. At finish—Wind E. by N., force 3; tide, 2½ hours ebb; barometer, 29·86; transparency, 3½ fathoms. |
| | | | | | " " | 2 | 13 | ... | ... | ... | ... | | |
| | | | | | Plaice, | 1 | 25 | 10 | 13½ | 51 | 11 | | |
| | | | | | " | 44 | 9½ | 23 | 8 | 8 | 6 | | |
| | | | | | Lemon soles, | 1 | 14 | 2 | 11 | ... | ... | | |
| | | | | | Common dabs, | 3 | 9½ | 5 | 8 | 5 | 7 | | |
| | | | | | " " | 1 | 6½ | ... | ... | ... | ... | | |
| | E. 53·5 | 47·5 | 45·1 | Bottom-net. — *Calanus finmarchicus*, fr.; *Dias longiremis*, f.; *Temora longicornis*, f.; *Caligus rapax*, r.; larval *Balani*, f.; post-larval fish, r. | Long rough dabs, | 2 | 9 | 1 | 8 | 1 | 6 | | |
| | | | | | Cod, | 1 | 22 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, | 6 | 13½ | 31 | 10½ | 23 | 7 | | |
| | | | | | " " | 3 | 5 | ... | ... | ... | ... | | |
| | | | | | Anglers, | 1 | 15 | 3 | 13 | 1 | 8 | | |
| STATION V. 6th May 9.0 a.m. to 11.5 a.m. | E. 43·4 | 44·4 | 41·8 22 fath. | Surface-net.—*Parathemisto*, sp. f.; *Calanus finmarchicus*, fr.; *Dias longiremis*, fr.; *Temora longicornis*, c.; *Centropages*, sp. fr.; fish ova, fr. | Starry ray, | 1 | 8 | ... | ... | ... | ... | *Fusus antiquus*, several; *Nephrops norvegicus*, r.; *Asterias*, sp. f.; *Hippasteria* | At beginning — Wind S.E., force 5; weather, overcast; sea, rough; tide, 2 hours flood; barometer, 30·09; transparency, 6 fathoms. |
| | | | | | Plaice, | 4 | 16½ | 10 | 15 | 6 | 12 | | |
| | | | | | " | 3 | 9 | ... | ... | ... | ... | | |
| | | | | | Lemon soles, | 15 | 1 | 8 | 13½ | 6 | 11 | | |
| | | | | | " " | 6 | 8½ | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 1 | 10 | 2 | 9 | 4 | 8 | | |

TABLE C.—Record of Observations made on Board the 'Garland' during 1891.—I. Firth of Forth—*continued.*

| Station, Date, and Time Trawl down. | Temperature. | | | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. | | | | | | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Air. | Water. | | | | | | | | | | | |
| | Dry Bulb. | Surface. | Bottom. | | | No. | Inches | No. | Inches | No. | Inches | | |
| Station V. 6th May 9.0 a.m. to 11.5 a.m. —*continued.* | W. 44·0 | 44·5 | 41·8 30 fath. | Bottom-net.—*Eolis*, sp. r.; *Boreophausia*, sp. f.; *Cuma*, sp. r.; *Calanus finmarchicus*, fr.; *Temora longicornis*, f.; *Caligus*, sp. f.; *Sagitta*, sp. c.; larval Decapods, fr.; post-larval fish, r. | Common dabs, | 10 | 6 | ... | ... | ... | ... | *plana*, r.; *Solaster endeca*, r.; *Actinoloba*, sp. r.; *Alcyonium*, sp. r. | At finish—Wind S.E., force 5; tide, 4 hours flood; barometer, 30·09; transparency, 6 fathoms. |
| | | | | | Flounder, | 1 | 12 | ... | ... | ... | ... | | |
| | | | | | Witch soles, | 2 | 17 | 1 | 15 | ... | ... | | |
| | | | | | Long rough dabs, | 1 | 12 | 23 | 8 | 3 | 4 | | |
| | | | | | Haddocks, | 1 | 19 | 6 | 11½ | 7 | 10 | | |
| | | | | | " | 1 | 8 | ... | ... | ... | ... | | |
| | | | | | Cod, | 2 | 26 | 4 | 13 | 6 | 11½ | | |
| | | | | | " | 5 | 9 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 1 | 12 | 7 | 9 | 4 | 7 | | |
| | | | | | " | 2 | 6 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, | 1 | 14 | 5 | 11 | 5 | 9 | | |
| | | | | | " | 8 | 7 | ... | ... | ... | ... | | |
| | | | | | Anglers, " | 1 | 21 | 2 | 13 | ... | ... | | |
| Station VI. 6th May 11.48 a.m. to 12.30 p.m. | E. 44·5 | 43·8 | 42·4 14 fath. | Surface-net. — *Parathemisto*, sp. r.; *Calanus finmarchicus*, f.; *Dias longiremis*, f.; *Temora longicornis*, fr.; *Centropages*, sp. f.; *Anomalocera*, sp. r.; larval Decapods, f.; fish ova, f. | Plaice, | 1 | 18 | 2 | 15 | 1 | 14 | | At beginning—Wind S.E., force 6; weather, hazy; sea, rough; tide, last ¼ flood; barometer, 30·06; transparency, 6¼ fathoms. |
| | | | | | " | 2 | 12½ | ... | ... | ... | ... | | |
| | | | | | Lemon soles, | 1 | 18½ | 1 | 11 | 1 | 8 | | |
| | | | | | Common dabs, | 1 | 9 | 2 | 8 | 1 | 7½ | | |
| | | | | | Long rough dabs, | 1 | 9 | 1 | 6 | ... | ... | | |
| | | | | | Cod, | 1 | 26 | 1 | 23 | 1 | 22 | | At finish — Wind, weather, sea, as before; tide, near high water; barometer, 30·05; transparency, 6 fathoms. |
| | W. 46·0 | 44·0 | 43·3 15 fath. | Bottom-net. — *Erythrops*, sp. r.; *Diastylis*, sp. r.; *Calanus finmarchicus*, f.; *Dias longiremis*, f.; *Temora longicornis*, f.; *Centropages*, sp. f.; *Sagitta*, sp. f.; larval *Balani*, f.; a quantity of sand | " | 1 | 9 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 1 | 12 | 1 | 11 | 2 | 10 | | |
| | | | | | Com. gurnards, | 1 | 12 | 1 | 9 | ... | ... | | |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1891.—I. FIRTH OF FORTH—*continued.*

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Water. Surface. | Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION VII. 5th May 12.20 p.m. to 3.0 p.m. | W. 51·0 | 45·0 | 45·2 11 fath. | Surface-net. — *Parathemisto*, sp. several; *Calanus finmarchicus*, f.; *Dias longiremis*, fr.; *Temora longicornis*, fr.; *Centropages*, sp. f.; larval *Balani*, f.; fish ova, f. | Thornback ray, | 1 | 17 | 1 | 16 | ... | ... | *Buccinum undatum*, r.; *Eupagurus bernhardus*, r.; *Amphidotus cordatus*, r.; *Solaster papposa*, r.; *Solaster endeca*, r.; *Asterias*, sp. fr.; *Alcyonium*, sp. fr. | At beginning — Wind S.E., force 7; weather, overcast; sea, rough; tide, high water; barometer, 30·08; transparency, 4½ fathoms. At finish—Wind, weather, sea, as before; tide, 2½ hours ebb; barometer, 30·08; transparency, 4½ fathoms. |
| | | | | | Plaice | 1 | 24 | 1 | 20 | 3 | 18 | | |
| | | | | | | 5 | 16 | 11 | 13 | 6 | 10 | | |
| | | | | | " | 1 | 8½ | 1 | 6 | ... | ... | | |
| | | | | | Lemon soles, | 1 | 13 | 1 | 11 | 3 | 9 | | |
| | E. 50·5 | 44·9 | 44·9 10 fath. | Bottom-net. — *Boreophausia*, sp. r.; *Pseudocuma cercaria*, r.; *Amathilla*, sp. r.; *Dulichia*, sp. r.; *Calanus finmarchicus*, f.; *Dias longiremis*, f.; *Temora longicornis*, f.; *Centropages*, sp. f.; *Alteutha*, sp. r.; *Caligus rapax*, f.; *Autolytus*, sp. several; *Sagitta*, sp. fr.; young Gastropods and Lamellibranchs, several; larval Ascidians, f.; larval *Balani*, c.; young starfish, f.; post-larval fish, f. | Common dabs, | 3 | 9 | 9 | 7 | 12 | 5 | | |
| | | | | | Flounders, | 2 | 11 | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 1 | 9½ | 2 | 8 | 3 | 7 | | |
| | | | | | " | 2 | 6 | ... | ... | ... | ... | | |
| | | | | | Haddocks, | 2 | 11 | 1 | 9½ | ... | ... | | |
| | | | | | Cod, | 1 | 23 | 1 | 16 | ... | ... | | |
| | | | | | Whitings, | 3 | 8 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, | 3 | 13 | 12 | 11 | 8 | 8 | | |
| | | | | | " " | 42 | 6½ | ... | ... | ... | ... | | |
| | | | | | Anglers, | 1 | 38 | 1 | 29 | 1 | 24 | | |
| | | | | | " | 1 | 13 | ... | ... | ... | ... | | |
| STATION VIII. 14th April 8.0 a.m. to 10.0 a.m. | S.W. 42·0 | 5·0 | 4·8 21 fath. | Surface-net.—*Parathemisto*, sp. r.; *Atylus*, sp. r.; *Calanus finmarchicus*, f.; *Dias longiremis*, f.; *Temora longicornis*, f.; *Sagitta*, sp. f., fish ova, c. | Thornback ray, | 1 | 26 | ... | ... | ... | ... | | At beginning — Wind W., force 1; weather, clear overhead, hazy round horizon; sea, smooth, easterly swell; tide, about 2 hours ebb; barometer, 30·11; transparency, 4 fathoms. At finish—Wind |
| | | | | | Plaice, | 1 | 17 | 1 | 9 | ... | . | | |
| | | | | | Lemon soles, | 1 | 13 | 2 | 11 | ... | ... | | |
| | | | | | Common dabs, | 1 | 9 | 4 | 8 | 9 | 6½ | | |
| | | | | | " " | 6 | 5½ | ... | ... | ... | ... | | |
| | | | | | Witch soles, | 1 | 17 | ... | ... | ... | ... | | |
| | N.E. 49·5 | 5·3 | 4·7 27. fath. | Middle-net (10 fath.).—*Calanus finmarchicus*, fr.; *Pseudocalanus elongatus*, fr.; *Temora longicornis*, c.; *Sagitta*, sp. fr.; larval Ascidians, f.; young Crus- | Long rough dabs, | 2 | 8 | 5 | 7 | 1 | 6½ | | |
| | | | | | " " | 1 | 4½ | ... | ... | ... | ... | | |
| | | | | | Turbot, | 1 | 28 | ... | ... | ... | ... | | |
| | | | | | Haddocks, | 4 | 12 | 4 | 10½ | 1 | 7 | | |
| | | | | | Cod, | 2 | 24½ | 1 | 27 | 3 | 11 | | |

TABLE C.—Record of Observations made on Board the 'Garland' during 1891.—I. Firth of Forth—*continued.*

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Temperature. Water. Surface. | Temperature. Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Tako. | No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c., brought up in Trawl Net. | Wnid, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station VIII. 14th April 8.0 a.m. to 10.0 a.m. —*continued.* | | | | tacea (Decapods, Schizopoda, *Balani*), fr.; young fish, f. Bottom-net. — *Boreophausia*, sp. r.; *Hyperia*, sp. r.; *Atylus*, sp. r.; *Cuma*, sp. r.; *Calanus*, sp. f.; *Pseudocalanus*, sp. f.; *Temora*, sp. fr.; *Sagitta*, sp. fr.; larval Crustacea, as in mid tow-net. | Cod, | 1 | 9 | ... | ... | ... | ... | | W. by S., force 1; weather and sea as before; tide, fully 4 hours ebb; barometer, 30·12; transparency, 7 fathoms. |
| | | | | | Whitings, | 4 | 14 | 4 | 12 | 9 | 10½ | | |
| | | | | | " | 2 | 9 | 10 | 8 | 1 | 6 | | |
| | | | | | " | 4 | 5 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, | 4 | 15 | 1 | 13 | 15 | 10½ | | |
| | | | | | " " | 2 | 8 | 2 | 6 | ... | ... | | |
| | | | | | Anglers, | 1 | 22 | 1 | 15 | .. | ... | | |
| | | | | | Cat-fish, | 1 | 19 | ... | ... | ... | ... | | |
| | | | | | Herrings, | 2 | 6½ | ... | ... | ... | ... | | |
| Station IX. 14th April 10.40 a.m. to 1.0 p.m. | N.W. 50·0 | 5·5 | 4·8 26 fath. | Surface-net. — *Parathemisto*, sp. r.; *Atylus*, sp. r.; *Calanus finmarchicus*, f.; *Dias longiremis*, f.; *Temora longicornis*, f.; *Sagitta*, sp. f.; fish ova, c. Middle-net (8 fath.).—*Parathemisto*, sp. fr.; *Atylus bispinosus*, fr.; *Calanus*, sp. f.; *Temora*, sp. fr.; *Sagitta*, sp. fr.; small Ctenophora, r.; larval Crustaceans, (Decapods, Schizopoda, Cirripedia), fr.; young fish. Bottom-net. — *Atylus bispinosus*, r.; *Pseudocalanus elongatus*, fr.; *Dias longiremis*, f.; *Temora longicornis*, fr.; *Alteutha*, sp. r.; *Sagitta*, sp. fr.; young *Mysis*, r.; very young Olphiuridæ, fr.; young fish, r. | Starry ray, | 1 | 11 | ... | ... | ... | ... | *Fusus antiquus*, 1; *Buccinum undatum*, r.; *Octopus vulgaris* (juv.), 1; *Nephrops norvegicus*, f.; *Solaster papposa*, r.; *Asterias rubens*, r.; *Actinoloba*, sp. r. | At beginning — Wind calm, force 0; weather, clear overhead, hazy round horizon; sea, smooth, easterly swell; tide, last ¼ ebb; barometer, 30·12; transparency, 8 fathoms. At finish—Wind, weather, sea, as before; tide, first of flood; barometer, 30·12; transparency, 10 fathoms. |
| | | | | | Plaice, | 1 | 18 | 1 | 15 | 1 | 13 | | |
| | | | | | Lemon soles, | 1 | 15 | 1 | 12 | 1 | 8 | | |
| | | | | | Common dabs, | 1 | 6½ | 1 | 5 | ... | ... | | |
| | | | | | Witch soles, | 1 | 14 | 1 | 11 | 1 | 10 | | |
| | S. E. 49·0 | 55·7 | 4·7 29 fath. | | Long rough dabs, | 2 | 9 | 2 | 8 | 1 | 6 | | |
| | | | | | " " | 2 | 5 | ... | ... | ... | ... | | |
| | | | | | Haddocks, | 6 | 11 | ... | ... | ... | ... | | |
| | | | | | Cod, | 2 | 22 | 1 | 19 | 1 | 10 | | |
| | | | | | Whitings, | 21 | 8 | 1 | 6 | ... | ... | | |
| | | | | | Hake, | 1 | 11 | ... | .. | ... | ... | | |
| | | | | | Com. gurnards, | 3 | 10 | 2 | 7 | ... | ... | | |
| | | | | | Anglers, | 1 | 29 | 2 | 27 | 1 | 15 | | |
| | | | | | " | 1 | 14 | 1 | 7 | ... | ... | | |
| | | | | | Herring, | 1 | 7 | ... | ... | ... | ... | | |
| | | | | | Four-bearded rockling, | 2 | 9 | ... | ... | ... | ... | | |

TABLE C.—Record of Observations made on Board the 'Garland' during 1891.—I. Firth of Forth—*continued.*

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Water. Surface. | Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station I.<br>23rd May<br>11.10 a.m. to 1.10 p.m. | E. 52·0<br>W. 55·6 | 48·0<br>48·0 | 45·0 15 fath.<br>46·5 14 fath. | Surface-net. — *Parathemisto*, sp. r.; *Atylus swammerdami*, r.; *Idotea emarginata*, r.; *Calanus finmarchicus* f.; *Dias*, sp. fr.; *Temora longicornis*, c.; *Centropages*, sp. fr.; *Anomalocera patersoni*, f.; *Sagitta*, sp. r.; larval Decapods, f.; fish ova, c.; post-larval lumpsucker, r.<br>Bottom-net.—*Calanus finmarchicus*, fr.; *Pseudocalanus elongatus*, f.; *Dias*, sp. f.; *Temora*, sp. f.; *Anomalocera*, sp. f.; *Caligus*, sp. f.; *Sagitta*, sp. c.; larval Decapods, fr.; larval Schizopods, r.; larval *Balani*, fr.; fish ova, f. | Thornback ray, | 1 | 27 | ... | ... | ... | ... | *Pecten opercularis*, f.; *Mytilus modiolus*, f.; *Asterias*, sp. f.; *Solaster papposa*, f.; *Echinus esculentus*, fr. | At beginning — Wind E., force 3; weather, a little hazy, fine; sea, slight; tide, nearly ½ flood; barometer, 29·64; transparency, 3½ fathoms.<br>At finish—Wind, weather, sea, as before; tide, last ¼ flood; barometer, 29·64; transparency, 4 fathoms. |
| | | | | | Plaice, | 2 | 15 | 13 | 13 | 12 | 11½ | | |
| | | | | | „ | 4 | 10 | ... | ... | ... | ... | | |
| | | | | | Lemon soles, | 1 | 14 | 6 | 10½ | 4 | 8½ | | |
| | | | | | „ „ | 2 | 6 | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 5 | 9 | 13 | 7½ | 13 | 6½ | | |
| | | | | | „ „ | 1 | 5½ | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 5 | 8½ | 17 | 7 | 1 | 6½ | | |
| | | | | | Haddocks, | 1 | 12½ | 6 | 11 | ... | ... | | |
| | | | | | Cod, | 1 | 28 | 2 | 19 | 1 | 17 | | |
| | | | | | „ | 3 | 13 | 1 | 7 | 1 | 8 | | |
| | | | | | Whitings, | 1 | 12 | 1 | 10 | ... | ... | | |
| | | | | | Com. gurnards, | 8 | 14 | 19 | 11 | 9 | 8½ | | |
| | | | | | „ | 3 | 7 | 7 | 5 | ... | ... | | |
| | | | | | Cat-fish, | 2 | 39 | 4 | 34 | 6 | 26 | | |
| | | | | | „ | 3 | 22 | ... | ... | ... | ... | | |
| Station II.<br>25th May<br>12.30 p.m. to 2.15 p.m. | E. 48·5<br>W. 51·0 | 47·2<br>47·0 | 46·8 14 fath.<br>50·6 12 fath. | Surface-net. — *Parathemisto*, sp. f.; *Calanus finmarchicus*, fr.; *Pseudocalanus elongatus*, f.; *Dias longiremis*, r.; *Temora longicornis*, c.; *Centropages*, sp. fr.; *Evadne*, sp. f.; larval Decapoda, fr.; fish ova, f.<br>Bottom-net. — *Parathemisto*, sp. f.; *Calanus*, sp. f.; *Pseudocalanus*, sp. f.; | Thornback ray, | 1 | 12 | ... | ... | ... | ... | *Asterias*, sp. fr.; *Solaster papposa*, f.; *Ophiothrix rosula*, fr.; *Alcyonium*, sp. f.; *Actinoloba*, sp. f. | At beginning—Wind E., force 6; weather, overcast; sea, rough; tide, ½ flood; barometer, 29·82; transparency, 3 fathoms.<br>At finish—Wind E.N.E., force 6; tide, last ¼ flood; barometer, 29·82; transparency, 4 fathoms. |
| | | | | | Plaice, | 4 | 15 | 32 | 13 | 42 | 11 | | |
| | | | | | „ | 13 | 9½ | ... | ... | ... | ... | | |
| | | | | | Lemon soles, | 1 | 12½ | 1 | 11 | 8 | 8 | | |
| | | | | | Common dabs, | 5 | 8 | 16 | 7 | 6 | 5½ | | |
| | | | | | Long rough dabs, | 2 | 11 | 3 | 10 | 8 | 8 | | |
| | | | | | „ „ | 8 | 7 | ... | ... | ... | ... | | |
| | | | | | Haddocks, | 3 | 12 | 3 | 11 | 2 | 10 | | |
| | | | | | Cod, | 1 | 13 | ... | ... | ... | ... | | |
| | | | | | Coal-fish, | 1 | 12 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 1 | 13 | 1 | 11 | ... | ... | | |
| | | | | | Com. gurnards, | 2 | 12 | 4 | 11 | 6 | 9 | | |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND DURING 1891.—I. FIRTH OF FORTH—*continued.*

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Water. Surface. | Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION II. 25th May 12.30 p.m. to 2.15 p.m. *continued.*— | | | | *Dias*, sp. f.; *Temora*, sp. f.; *Centropages*, sp. f.; *Evadne*, sp. fr.; *Sagitta*, sp. fr.; larval Decapoda, f. | Com. gurnards, . | 14 | $6\frac{1}{2}$ | ... | ... | ... | ... | | |
| | | | | | Anglers, . . | 1 | 44 | 2 | 15 | ... | ... | | |
| | | | | | Cat-fish, . . | 1 | 33 | 1 | 31 | 1 | 24 | | |
| STATION III. 27th May 2.0 p.m. to 4.35 p.m. | E. 52·8 | 47·0 | 47·0 $9\frac{1}{2}$ fath. | Surface-net.—*Parathemisto*, sp. c.; *Atylus bispinosus*, f.; *Calanus finmarchicus*, f.; *Pseudocalanus elongatus*, f.; *Temora longicornis*, c.; *Anomalocera patersonni*, fr.; *Evadne*, sp. fr.; *Podon*, sp. fr.; fish ova, fr.; post-larval fish, f. | Thornback ray, . | 1 | 22 | 1 | 15 | ... | ... | *Pecten opercularis*, c.; *Mytilus modiolus*, fr.; *Hyas coarctatus*, r.; *Asterias*, sp. fr.; *Solaster papposa*, fr.; *Solaster endeca*, r.; *Echinus esculentus*, fr.; *Alcyonium*, sp. f. | At beginning — Wind E., force 4; weather, becoming overcast; sea, moderate; tide, about $2\frac{1}{2}$ hours flood; barometer, 29·54; transparency, $3\frac{1}{2}$ fathoms. At finish—Wind E.N.E., force 6; weather, a little hazy; sea, moderate; tide, 5 hours flood; barometer, 29·54; transparency, $3\frac{1}{2}$ fathoms. |
| | | | | | Plaice, . . | 1 | 14 | 51 | 12 | 5 | 10 | | |
| | | | | | Lemon soles, . | 4 | 13 | 13 | 11 | 20 | $9\frac{1}{2}$ | | |
| | | | | | " " . | 14 | $7\frac{1}{2}$ | ... | ... | ... | ... | | |
| | | | | | Common dabs, . | 4 | 9 | 11 | $7\frac{1}{2}$ | 11 | 6 | | |
| | | | | | Flounder, . . | 1 | 9 | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 8 | 10 | 7 | 9 | 8 | 6 | | |
| | | | | | Haddock, . . | 1 | 11 | ... | ... | ... | ... | | |
| | W. 49·0 | 47·0 | 47·1 11 fath. | Bottom-net.—*Parathemisto*, sp. fr.; *Atylus*, sp. r.; *Calanus*, sp. f.; *Dias*, sp. f.; *Temora*, sp. fr.; *Centropages*, sp. fr.; *Evadne*, sp. fr.; *Podon*, sp. fr.; *Caligus*, sp. r.; larval Decapods, fr.; larval *Balani*, fr.; *Sagitta*, sp. fr. | Cod, . . . | 1 | 21 | 5 | 15 | 7 | 13 | | |
| | | | | | " . . . | 9 | 10 | ... | ... | ... | ... | | |
| | | | | | Whitings, . . | 1 | 12 | 8 | 11 | 1 | 10 | | |
| | | | | | " . . | 8 | 9 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, . | 1 | 14 | 8 | 12 | 15 | 10 | | |
| | | | | | " " . | 29 | 44 | 7 | ... | ... | ... | | |
| | | | | | Anglers, . . | 2 | 26 | 1 | 21 | 2 | 15 | | |
| | | | | | Cat-fish, . | 1 | 23 | ... | .. | ... | ... | | |
| STATION IV. 28th May 11.45 a.m. to 3.0 p.m. | E. 48·9 | 46·5 | 47·0 5 fath. | Surface-net.—*Parathemisto*, sp. fr.; *Calanus finmarchicus*, fr.; *Temora longicornis*, fr.; *Evadne*, sp. fr.; *Sagitta*, sp. fr.; larval *Balani*, f.; exuviæ | Thornback ray, . | 1 | 26 | 5 | 20 | 2 | 17 | *Pecten opercularis*, ab.; *Mytilus modiolus*, fr.; *Fusus antiquus*, several; *Nudibranchs*, f.; *Nephrops*, sp. r.; | At beginning — Wind E., force 5; weather, overcast; sea, moderate; tide, first $\frac{1}{4}$ flood; barometer, 29·73; transparency, $2\frac{1}{2}$ fathoms. |
| | | | | | Plaice, . . | 1 | 24 | 44 | 14 | 101 | $10\frac{1}{2}$ | | |
| | | | | | " . . | 36 | $7\frac{1}{2}$ | ... | ... | ... | ... | | |
| | | | | | Lemon soles, . | 1 | 12 | 9 | 10 | ... | ... | | |
| | | | | | Common dabs, . | 4 | $10\frac{1}{2}$ | 1 | 12 | 14 | $8\frac{1}{2}$ | | |
| | | | | | " " . | 25 | $6\frac{1}{2}$ | ... | ... | ... | ... | | |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1891.—I. FIRTH OF FORTH—*continued.*

| Station, Date, and Time Trawl down. | Temperature. | | | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. | | | | | | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Air. | Water. | | | | | | | | | | | |
| | Dry Bulb. | Surface. | Bottom. | | | No. | Inches | No. | Inches | No. | Inches | | |
| STATION IV. 26th May 11.45 a.m. to 3.0 p.m. —*continued.* | W. 49·2 | 47·5 | 47·7 5½ fath. | of *Balanus*, fr.; fish ova, f.; mud, suspended in water, considerable quantity. Bottom-net.—*Parathemisto*, sp. fr.; *Calanus*, sp. f.; *Temora*, sp. c.; *Evadne*, sp. fr.; *Podon*, sp. fr.; *Sagitta*, sp. r.; fish ova, fr. | Flounder, | 1 | 7 | ... | ... | ... | ... | *Hyas coarctatus*, f.; *Portunus depurator*, f.; *Eupagurus*, sp. f.; *Echinus esculentus*, r.; *Asterias*, sp. f.; *Solaster papposa*, f.; *Flustra securifrons*, several; *Hydrallmannia*, sp. fr.; *Porifera*, f.; *Weed*, f. | At finish—Tide, last ½ flood; barometer, 29·69; transparency, 2 fathoms. |
| | | | | | Long rough dabs, | 1 | 10 | 4 | 7 | ... | ... | | |
| | | | | | Cod, | 1 | 24 | 1 | 16 | 4 | 13 | | |
| | | | | | " | 1 | 11 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, | 5 | 15½ | 24 | 11 | 13 | 8½ | | |
| | | | | | " " | 29 | 6½ | ... | ... | ... | ... | | |
| | | | | | Anglers, | 2 | 24 | 7 | 16 | 1 | 11 | | |
| | | | | | " | 1 | 7 | ... | ... | ... | ... | | |
| | | | | | Dragonet, | 1 | 7 | ... | ... | ... | ... | | |
| STATION V. 28th May 1.10 p.m. to 3.25 p.m. | E. 47·2 | 47·1 | 44·4 22 fath. | Surface-net. — *Boreophausia*, sp. r.; *Parathemisto*, sp. f.; *Calanus finmarchicus*, f.; *Dias longiremis*, f.; *Temora longicornis*, f.; *Centropages*, sp. fr.; *Anomalocera patersonni*, fr.; *Evadne*, sp. fr.; larval Decapoda, c.; fish ova, fr. | Plaice, | 3 | 17 | 11 | 15 | 7 | 13 | *Fusus antiquus*, r.; *Nephrops norvegicus*, r.; *Asterias*, sp. fr.; *Solaster endeca*, r.; *Alcyonium*, sp. r.; some weed. | At beginning — Wind E. by S., force 5; weather, hazy; sea, moderate; tide, first ½ flood; barometer, 29·54; transparency, 6½ fathoms. At finish—Wind E. by S., force 2; weather, as before; sea, slight; tide, fully ½ flood; barometer, 29·54; transparency, 6 fathoms. |
| | | | | | " | 4 | 8–10 | ... | ... | ... | ... | | |
| | | | | | Lemon soles, | 2 | 14 | 5 | 12 | 3 | 10 | | |
| | | | | | " " | 2 | 7½ | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 4 | 9 | 6 | 7 | 2 | 4½ | | |
| | | | | | Witch soles, | 2 | 18 | 2 | 15 | 3 | 13 | | |
| | | | | | Long rough dabs, | 1 | 12 | 9 | 10 | 24 | 7-8 | | |
| | | | | | " " | 12 | 3½-5 | ... | ... | ... | ... | | |
| | | | | | Sole, | 1 | 14½ | ... | ... | ... | ... | | |
| | | | | | Haddocks, | 3 | 18 | 2 | 15 | 3 | 13 | | |
| | W. 52·0 | 47·5 | 44·5 28 fath. | Bottom-net.—*Calanus*, sp. fr.; *Dias*, sp. f.; *Temora*, sp. c.; *Centropages*, sp. fr.; *Evadne*, sp. f.; *Sagitta*, sp. ab.; larval Decapoda, fr.; post-larval fish, r. | " | 10 | 8½-11 | ... | ... | ... | ... | | |
| | | | | | Cod, | 1 | 26 | 5 | 13 | 6 | 10 | | |
| | | | | | " | 4 | 9 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 5 | 14 | 1 | 9 | 1 | 8 | | |
| | | | | | Com. gurnards, | 13 | 13 | 18 | 11 | 1 | 15 | | |
| | | | | | " " | 6 | 6½ | ... | ... | ... | ... | | |
| | | | | | Anglers, | 1 | 26 | 1 | 8 | ... | ... | | |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1891.—I. FIRTH OF FORTH—*continued.*

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Temperature. Water. Surface. | Temperature. Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION VI. 28th May 11.5 a.m. to 12.10 p.m. | W. 48·4<br>E. 48·0 | 46·5<br>46·7 | 45·6 15 fath.<br>Bottom Thermometer damaged. | Surface-net.—*Parathemisto*, sp. r.; *Calanus finmarchicus*, f.; *Temora longicornis*, fr.; *Centropages*, sp. f.; *Anomalocera patersonni*, fr.; young Gastropoda, fr.; larval Decapoda, r.; some fish ova. Bottom-net.—*Calanus finmarchicus*, f.; *Dias longiremis*, f.; *Temora longicornis*, f.; *Evadne*, sp. r.; *Sagitta*, sp. f.; larval Ascidians, r.; larval *Balani*, r. | Plaice, | 1 | 17 | 20 | 14 | 5 | 12 | *Mytilus modiolus*, r.; *Fusus antiquus*, r.; *Eupagurus*, sp. r.; *Asterias*, sp. fr.; *Solaster endeca*, r.; *Astropecten irregularis*, r.; *Spatangus purpureus*, r.; *Alcyonium*, sp. r.; (very little in net). | At beginning—Wind E. by S., force 5; weather, hazy; sea, moderate; tide, 5 hours ebb; barometer, 29·52; transparency, 5½ fathoms. At finish — Wind, weather, sea, as before; tide, about low water; barometer, 29·53; transparency, 5 fathoms. |
| | | | | | Lemon soles, | 3 | 13 | 3 | 10½ | 1 | 9 | | |
| | | | | | Common dabs, | 4 | 7½ | 12 | 6 | ... | ... | | |
| | | | | | Cod, | 1 | 23 | 2 | 17 | 2 | 14 | | |
| | | | | | " | 1 | 10 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 1 | 10 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, | 2 | 11 | 2 | 10 | 3 | 8 | | |
| | | | | | " " | 2 | 7 | ... | ... | ... | ... | | |
| | | | | | Anglers, | 1 | 33 | 2 | 15 | ... | ... | | |
| STATION VII. 27th May 10.35 a.m. to 12.45 p.m. | W. 48·5<br>E. 48·0 | 45·7<br>46·0 | 45·8 11 fath.<br>45·2 15 fath. | Surface-net.—*Parathemisto*, sp. c.; *Idotea marina*, r.; *Calanus finmarchicus*, f.; *Dias longiremis*, fr.; *Temora longicornis*, f.; *Centropages*, sp. fr.; *Anomalocera patersonni*, fr.; *Sagitta*, sp. f.; larval Decapoda, fr.; fish ova, f. Bottom-net.—*Parathemisto*, sp. f.; *Calanus finmarchicus*, fr.; *Pseudocalanus*, sp. f.; *Temora*, sp. c.; *Sagitta*, sp. c.; larval Decapod Crustacea, fr.; larval *Balani*, f.; post-larval fish, f. | Plaice, | 4 | 13 | 15 | 10½ | 4 | 8½ | *Fusus antiquus*, f.; *Asterias*, sp. several; *Echinus esculentus*, r.; *Alcyonium*, sp. f.; *Actinoloba*, sp. r.; (very little in net). | At beginning—Wind calm, force 0; weather, overcast, showery; sea, moderate; tide, low water; barometer, 29·52; transparency, 3½ fathoms. At finish—Wind E., force 4; weather, a little hazy, fine; sea, moderate; tide, fully 2 hours flood; barometer, 29·54; transparency, 4 fathoms. |
| | | | | | " | 1 | 6½ | ... | ... | ... | ... | | |
| | | | | | Lemon soles, | 4 | 10 | 6 | 8½ | 7 | 6½ | | |
| | | | | | Common dabs, | 4 | 9 | 64 | 7 | 9 | 4½ | | |
| | | | | | " " | 1 | 3½ | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 1 | 14 | 1 | 12 | 7 | 8 | | |
| | | | | | " " | 7 | 6½ | ... | ... | ... | ... | | |
| | | | | | Haddocks, | 6 | 12 | 3 | 11 | 1 | 7½ | | |
| | | | | | Whitings, | 1 | 11 | 1 | 9 | 1 | 8 | | |
| | | | | | Com. gurnards, | 4 | 14½ | 6 | 12 | 23 | 10 | | |
| | | | | | " " | 51 | 6½ | ... | ... | ... | ... | | |
| | | | | | Anglers, | 5 | 15 | ... | ... | ... | ... | | |

TABLE C.—Record of Observations made on Board the 'Garland' during 1891.—I. Firth of Forth—*continued.*

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Water. Surface. | Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station VIII. 29th May 10.50 a.m. to 12.45 p.m. | S.W. 48·0 | 46·2 | 45·0 22 fath. | Surface-net. — *Boreophausia*, sp. r.; *Parathemisto*, sp. c.; *Calanus finmarchicus*, f.; *Dias longiremis*, f.; *Temora longicornis*, f.; *Centropages*, sp. f.; *Anomalocera patersonni*, fr.; larval Crustacea, ab.; fish ova, f. Bottom-net. — *Atylus bispinosus*, f.; *Calanus finmarchicus*, f.; *Temora longicornis*, f.; *Sagitta*, sp. ab.; larval *Balani*, f. | Grey skate, . | 1 | 16 | 2 | 15 | 3 | 13 | *Nephrops norvegicus*, r.; *Asterias*, sp. f.; *Solaster*, sp. f.; *Actinoloba*, sp.; several. | At beginning—Wind E.S.E., force 1; weather, cloudy, showery; sea, strong easterly swell; tide, about 4 hours ebb; barometer, 29·57, transparency, 5 fathoms. At finish—Wind S.E., force 5; weather, cloudy; sea, as before; tide, low water; barometer, 29·57; transparency, 7 fathoms. |
| | | | | | ,, ,, . | 2 | 10½ | ... | ... | ... | ... | | |
| | | | | | Lemon soles, . | 1 | 8 | ... | ... | ... | ... | | |
| | | | | | Common dabs, . | 1 | 10 | 1 | 9 | 15 | 7 | | |
| | | | | | ,, ,, . | 4 | 4 | ... | ... | ... | ... | | |
| | | | | | Witch soles, . | 3 | 19 | 3 | 17 | 1 | 14 | | |
| | | | | | ,, ,, . | 1 | 12 | ... | ... | ... | ... | | |
| | N.E. 51·0 | 46·7 | 44·2 26 fath. | | Long rough dabs, . | 13 | 8 | 11 | 5½ | 6 | 4–4½ | | |
| | | | | | Haddocks, . . | 5 | 11 | 1 | 9 | ... | ... | | |
| | | | | | Cod, . . . | 1 | 7 | ... | ... | ... | ... | | |
| | | | | | Whitings, . . | 1 | 11 | 1 | 10 | ... | ... | | |
| | | | | | Com. gurnards, . | 6 | 12 | 23 | 10 | 10 | 7 | | |
| Station IX. 29th May 1.0 p.m. to 2.50 p.m. | N.W. 50·5 | 46·7 | 44·3 26 fath. | Surface-net. — *Parathemisto*, sp. c.; *Calanus finmarchicus*, f.; *Dias longiremis*, f.; *Temora longicornis*, f.; *Centropages*, sp. f.; *Anomalocera patersonni*, several; fish-ova, fr. Bottom-net. — *Atylus bispinosus*, f.; *Calanus*, sp. f.; *Temora*, sp. f.; *Sagitta*, sp. ab.; larval *Balani*, f. | Grey skate, . | 1 | 17 | ... | ... | ... | ... | *Nephrops norvegicus*, r.; *Eupagurus bernhardus*, r.; *Asterias*, sp. several; *Solaster*, sp. r. | At beginning — Wind S.E., force 5; weather, cloudy; sea, strong easterly swell; tide, first of flood; barometer, 29·58; transparency, 7 fathoms. At finish—Wind S., force 4; tide, fully 2 hours flood; barometer, 29·60; transparency, 7½ fathoms. |
| | | | | | Plaice, . . | 1 | 18 | 1 | 16 | ... | ... | | |
| | | | | | Lemon soles, . | 1 | 15 | 1 | 12 | 1 | 9 | | |
| | | | | | Common dabs, . | 3 | 9 | 8 | 7½ | 2 | 5½ | | |
| | | | | | ,, ,, . | 1 | 4 | ... | ... | ... | ... | | |
| | S.E. 51·0 | 46·7 | 42·9 32 fath. | | Witch soles, . | 1 | 17 | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 1 | 8 | 5 | 7 | 12 | 5½ | | |
| | | | | | ,, ,, . | 4 | 4 | ... | ... | ... | ... | | |
| | | | | | Turbot, ,, . | 1 | 26 | ... | ... | ... | ... | | |
| | | | | | Haddocks, . . | 1 | 15 | 6 | 12 | 4 | 10 | | |
| | | | | | Whitings, . . | 4 | 14 | 4 | 12 | 2 | 11 | | |
| | | | | | ,, . | 1 | 10 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, . | 2 | 12 | 5 | 10 | 2 | 9 | | |
| | | | | | ,, . | 1 | 7 | ... | ... | ... | ... | | |
| | | | | | Anglers, ,, . | 1 | 29 | 1 | 25 | 2 | 19 | | |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1891.—I. FIRTH OF FORTH—*continued.*

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Water. Surface. | Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION I. 22nd June 1.50 p.m. to 4.30 p.m. | E. 58·9 | 12·8 | 47·5 16 fath. | Surface-net. — *Parathemisto*, sp. f.; *Calanus finmarchicus*, c.; *Temora longicornis*, fr.; *Dias longiremis*, fr.; *Centropages*, sp. f.; *Sagitta*, sp. f.; larval Decapod Crustacea, fr.; fish ova, fr. | Grey skate, | 1 | 13¾ | ... | ... | ... | ... | *Pecten opercularis*, fr.; *Solaster papposa*, c.; *Echinus esculentus*, c.; *Alcyonium*, sp. c.; a quantity of dead molluscan shells and some rubbish. | At beginning — Wind E.S.E., force 4; weather, hazy; sea, slight; tide, near high water; barometer, 30·31; transparency, 4½ fathoms. |
| | | | | | Plaice, | 8 | 15½ | 38 | 12 | 32 | 10½ | | |
| | | | | | ,, | 9 | 7-9 | ... | ... | ... | ... | | |
| | | | | | Lemon soles, | 5 | 15 | 5 | 12 | 15 | 10½ | | |
| | | | | | ,, ,, | 27 | 7½-9 | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 4 | 9½ | 91 | 7½ | 18 | 5½ | | |
| | | | | | ,, ,, | 11 | 4 | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 1 | 14 | 9 | 9½ | 17 | 8 | | At finish—Wind E., force 4; weather, hazy; sea, moderate; tide, about 2 hours ebb; barometer, 30·31; transparency, 3½ fathoms. |
| | W. 58·0 | 13·3 | 49·0 12 fath. | Bottom-net. — *Tauria medusarum*, r.; *Calanus finmarchicus*, fr.; *Temora longicornis*, fr.; *Sagitta*, sp. fr.; small Ctenophora, fr.; larval Decapod Crustacea, fr.; larval *Balanus*, sp. (*Cypris*-stage), fr. | ,, ,, | 5 | 6½ | ... | ... | ... | ... | | |
| | | | | | Haddocks, | 24 | 12 | 13 | 9½ | 8 | 8 | | |
| | | | | | Cod, | 5 | 14 | 5 | 11 | 5 | 9½ | | |
| | | | | | ,, | 6 | 7½ | ... | ... | ... | ... | | |
| | | | | | Whitings, | 7 | 14½ | 16 | 12 | 7 | 9 | | |
| | | | | | Com. gurnards, | 10 | 11½ | 5 | 10 | 51 | 6 | | |
| | | | | | Dragonet, | 1 | 9 | 1 | 7½ | ... | ... | | |
| | | | | | Pogge, | 1 | 5½ | ... | ... | ... | ... | | |
| STATION II. 22nd June 11.30 a.m to 1.10 p.m. | E. 56·5 | 13·0 | 49·0 11 fath. | Surface-net. — *Parathemisto*, sp. f.; *Calanus finmarchicus*, c.; *Temora longicornis*, fr.; *Centropages*, sp. f.; larval Decapod Crustacea, fr.; *Sagitta*, sp. r.; fish ova, fr.; young fish, r. | Thornback ray, | 1 | 14 | ... | ... | ... | ... | *Fusus antiquus*, several; *Ascidians*, several; *Asterias*, sp. f.; *Ophiothrix rosula*, c.; *Solaster papposa*, several; *Astropecten irregularis*, r.; *Echinus esculentus*, f.; *Alcyonium*, | At beginning — Wind calm, force 0; weather, foggy; sea, smooth; tide, about ½ flood; barometer, 30·32; transparency, 3 fathoms. |
| | | | | | Plaice, | 2 | 6½ | 45 | 13 | 25 | 10 | | |
| | | | | | ,, | 8 | 8 | ... | ... | ... | ... | | |
| | | | | | Lemon soles, | 1 | 13 | 3 | 11 | 3 | 9½ | | |
| | | | | | ,, ,, | 7 | 7½ | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 2 | 9½ | 8 | 8 | 93 | 5½-6½ | | |
| | | | | | ,, ,, | 15 | 4 | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 2 | 11 | 2 | 9 | 7 | 7-8 | | At finish—Wind S.E., force 1; weather, hazy; sea, smooth; tide, last ½ flood; barometer, |
| | W. 59·0 | 12·8 | 48·7 13 fath. | Bottom-net. — *Tauria*, sp. r.; *Calanus finmarchicus*, fr.; *Temora longicornis*, fr.; *Parapontella brevi-* | Haddocks, | 1 | 13 | 17 | 11 | 17 | 9 | | |
| | | | | | ,, | 2 | 7½ | ... | ... | ... | ... | | |
| | | | | | Cod, | 2 | 13 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 2 | 15 | 4 | 12 | 3 | 10 | | |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1891.—I. FIRTH OF FORTH—*continued.*

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Temperature. Water. Surface. | Temperature. Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c., brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION II. 22nd June 11.30 a.m. to 1.10 p.m. —*continued.* | | | | *cornis*, f.; *Sagitta*, sp. fr.; larval *Balanus*, sp. fr.; small Ctenophora, fr.; larval Decapod Crustacea, fr. | Whitings, | 2 | 9 | ... | ... | ... | ... | sp. c.; a number of dead molluscan shells. | 30·31; transparency, 4 fathoms. |
| | | | | | Com. gurnards, | 1 | 13½ | 7 | 12 | 29 | 6-7 | | |
| | | | | | " " | 3 | 4 | ... | ... | ... | ... | | |
| | | | | | Anglers, | 1 | 12 | 1 | 6½ | ... | ... | | |
| STATION III. 20th June 10.55 a.m. to 12.55 p.m. | E. 60·0 | 13·0c | 47·0 12 fath. | Surface-net. — *Boreophausia*, sp. f.; *Calanus finmarchicus*, c.; *Temora longicornis*, fr.; *Dias longiremis*, f.; *Centropages*, sp. fr.; *Anomalocera patersonni*, f.; *Evadne*, sp. fr.; *Podon*, sp. fr.; fish ova, c. | Plaice, | 21 | 12½ | 11 | 11 | 2 | 10 | *Pecten opercularis*, fr.; *Mytilus modiolus*, f.; *Loligo*, sp. (juv.), several; *Fusus antiquus*, r.; *Hyas coarctatus*, r.; *Nephrops*, sp. several; *Asterias*, sp. f.; *Solaster papposa*, fr.; *Ophiothrix rosula*, f.; *Echinus esculentus*, f.; *Aphrodite*, sp. r.; a quantity of rubbish. | At beginning — Wind E., force 2; weather, foggy; sea, slight; tide, 4 hours flood; barometer, 20·32; transparency, 3 fathoms. At finish—Wind E., force 3; weather and sea as before; tide, high water; barometer and transparency as before. |
| | | | | | " | 2 | 8 | ... | ... | ... | ... | | |
| | | | | | Lemon soles, | 3 | 13½ | 21 | 11 | 17 | 8½ | | |
| | | | | | " " | 6 | 7 | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 15 | 9 | 25 | 7½ | 46 | 6 | | |
| | | | | | " " | 3 | 8 | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 1 | 12 | 6 | 11 | 9 | 8 | | |
| | W. 60·5 | 13·0c | 47·0 13½ fath. | Bottom-net. — *Boreophausia*, sp. (jun.), fr.; *Atylus*, sp. r.; *Tauria*, sp. f.; *Parathemisto*, sp. f.; *Calanus finmarchicus*, c.; *Pseudocalanus*, sp. fr.; *Temora longicornis*, c.; *Dias longiremis*, fr.; *Alteutha depressa*, r.; *Thalestris longimanus*, r.; *Evadne*, sp. fr.; *Sagitta*, sp. c.; small Ctenophora, f.; post-larval fish, r. | " " | 1 | 4½ | ... | ... | ... | ... | | |
| | | | | | Haddock, | 1 | 11 | ... | .. | ... | ... | | |
| | | | | | Cod, | 9 | 13½ | 4 | 11 | 4 | 9 | | |
| | | | | | " | 1 | 7 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 1 | 14½ | 7 | 12 | 10 | 9½ | | |
| | | | | | Com. gurnards, | 2 | 12 | 1 | 10 | 13 | 7 | | |
| | | | | | " " | 1 | 4 | ... | ... | ... | ... | | |
| | | | | | Anglers, | 2 | 32 | 2 | 17 | ... | ... | | |
| STATION IV. 18th June 10.30 a.m. to 1.45 p.m. | W. 63·0 | 12·1 | 52·8 4 fath. | Surface-net. — *Gammarus*, sp. several; *Parathemisto*, sp. f.; *Calanus finmarchicus*, f.; *Dias*, sp. f.; | Thornback ray, | 3 | 19 | 6 | 15 | ... | ... | *Pecten opercularis*, c.; *Mytilus modiolus*, several; Nudibranch | At beginning — Wind W., force 5; weather, overcast; sea, slight; tide, ¾ |
| | | | | | Plaice, | 14 | 14 | 66 | 12½ | 54 | 10½ | | |
| | | | | | " | 167 | 8½-10½ | ... | ... | ... | ... | | |
| | | | | | Lemon soles, | 1 | 11 | 2 | 9 | 5 | 7½ | | |

TABLE C.—Record of Observations made on Board the 'Garland' during 1891.—I. Firth of Forth—*continued*.

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Water. Surface. | Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station IV. 18th June 10.30 a.m. to 1.45 p.m. *continued*.— | E. 59·5 | 11·4 | 53·1 6 fath. | *Evadne*, fr.; young lump-sucker, r.; fish ova, very few. Bottom-net. — *Atylus bispinosus*, r.; *Calanus finmarchicus*, f.; small Ctenophora, fr.; larval Decapod Crustacea, f.; very little in net. | Common dabs, | 4 | 13 | 2 | 10½ | 20 | 8½ | Mollusca, r.; *Ascidians*, f.; *Portunus depurator*, f.; *Portunus holsatus*, f.; *Solaster papposa*, f.; *Ophiothrix rosula*, f.; *Echinus esculentus*, f.; *Echinus miliarus*, f.; *Chalina*, sp. fr. | flood; barometer, 30·12; transparency, 2½ fathoms. At finish—Wind N.W. by W., force 4; tide, first ½ ebb; barometer, 30·13; transparency, 2½ fathoms. |
| | | | | | " " | 21 | 6–7 | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 1 | 12 | 2 | 8 | 1 | 4 | | |
| | | | | | Cod, | 1 | 22 | 10 | 15 | 2 | 12 | | |
| | | | | | " | 1 | 8 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 1 | 10 | 2 | 9 | ... | ... | | |
| | | | | | Com. gurnards, | 1 | 16 | 1 | 14½ | 6 | 13½ | | |
| | | | | | " " | 1 | 8 | ... | ... | ... | ... | | |
| | | | | | Anglers, | 1 | 27 | 1 | 16 | 1 | 14 | | |
| Station V. 19th June 11.20 a.m. to 1.45 p.m. | W. 62·8 | 10·7 | 45·9 30 fath. | Surface-net. — *Calanus finmarchicus*, fr.; *Dias*, sp. fr.; *Centropages*, sp. f.; *Anomalocera patersonni*, fr.; *Evadne*, sp. fr.; *Sagitta*, sp. r.; fish ova, f.; young round fish, 1. Bottom-net destroyed, from getting filled with mud. | Grey skate, | 1 | 17 | ... | ... | ... | ... | *Nephrops*, sp. several; a few *Asterias*, sp.; *Solaster papposa* and *Actinoloba dianthus*. | At beginning — Wind W.N.W., force 3; weather, hazy; sea, slight; tide, near high water; barometer, 30·26; transparency, 6 fathoms. At finish—Wind E.S.E., force 2; weather, hazy; sea, smooth; tide, first ½ ebb; barometer, 30·26; transparency, 6 fathoms |
| | | | | | Starry ray, | 1 | 11 | 2 | 7½ | ... | ... | | |
| | | | | | Plaice, | 1 | 23 | 3 | 19 | 15 | 13½–15 | | |
| | | | | | " | 2 | 9½ | ... | ... | ... | ... | | |
| | | | | | Lemon soles, | 2 | 14 | 3 | 10½ | 3 | 9½ | | |
| | | | | | " " | 4 | 7½ | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 1 | 9 | 6 | 8 | ... | ... | | |
| | E. 57·8 | 10·0 | 45·2 22 fath. | | Witch soles, | 2 | 18 | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 1 | 12 | 2 | 11 | 16 | 8·9 | | |
| | | | | | " " | 24 | 5–6 | ... | ... | ... | ... | | |
| | | | | | Haddocks, | 2 | 18½ | 6 | 14½ | 26 | 12 | | |
| | | | | | " | 59 | 8–10 | ... | ... | ... | ... | | |
| | | | | | Cod, | 3 | 24 | 1 | 17 | 1 | 13 | | |
| | | | | | " | 5 | 9–11 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 3 | 14 | 5 | 12 | 6 | 10 | | |
| | | | | | " | 5 | 6–8 | ... | ... | ... | ... | | |

TABLE C.—Record of Observations made on Board the 'Garland' during 1891.—I. Firth of Forth—*continued.*

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Temperature. Water. Surface. | Temperature. Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c., brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station V. 19th June 11.20 a.m. to 1.45 p.m. *continued.*— | | | | | Ling, | 1 | 17½ | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, | 1 | 13 | 5 | 12 | 9 | 10 | | |
| | | | | | " " | 34 | 6½–7 | ... | ... | ... | ... | | |
| | | | | | Anglers, | 1 | 30 | 1 | 26 | ... | ... | | |
| Station VI. 24th June 2.45 p.m. to 3.30 p.m. | E. 55·5 | 11·3 | 50·8 15 fath. | Surface-net.—*Parathemisto*, sp. r.; *Calanus finmarchicus*, ab.; *Temora longicornis*, f.; *Dias*, sp. f.; *Centropages*, sp. f.; *Anomalocera patersonni*, f.; *Evadne*, sp. fr.; *Sagitta*, sp. f.; Ctenophora, f.; larval Gastropod Mollusca, c.; Plutei, fr. | Plaice, | 1 | 18 | 3 | 16 | 3 | 15 | | At beginning — Wind E.N.E., force 4; weather, hazy; sea, strong easterly swell; tide, last ¼ flood; barometer, 30·13; transparency, 5½ fathoms. At finish — Tide, near high water; barometer, 30·13; transparency, 5 fathoms. |
| | | | | | " | 4 | 13 | ... | ... | ... | ... | | |
| | | | | | Lemon soles, | 1 | 13½ | 2 | 7½ | ... | ... | | |
| | | | | | Common dabs, | 1 | 9 | 1 | 8 | 4 | 7 | | |
| | | | | | Turbot, | 1 | 28 | ... | ... | ... | ... | | |
| | | | | | Cod, | 2 | 13 | 1 | 12 | ... | ... | | |
| | | | | | Whitings, | 2 | 12 | 11 | 11 | 6 | 10 | | |
| | | | | | " | 1 | 8 | ... | ... | ... | ... | | |
| | W. 56·7 | 11·6 | 51·0 14½ fath. | Bottom-net. — *Tauria*, sp. f.; *Calanus finmarchicus*, fr.; *Temora longicornis*, f.; *Dias longiremis*, fr.; *Alteutha depressa*, r; *Caligus*, sp. r.; *Evadne*, sp. fr., young Gastropod Mollusca, fr.; larval *Balanus*, sp. fr. | Com. gurnards, | 1 | 12½ | 9 | 11 | 4 | 9 | | |
| | | | | | " " | 15 | 8 | 29 | 6–7 | ... | ... | | |
| | | | | | Anglers, | 1 | 29 | ... | ... | ... | ... | | |
| Station VII. 23rd June 12.35 p.m. to 2.15 p.m. | E. 58·0 | 11·8 | 47·3 18 fath | Surface-net. — *Parathemisto*, sp. r.; *Calanus finmarchicus*, c.; *Temora longicornis*, f.; *Anomalocera patersonni*, f.; small Ctenophora, c.; fish ova, f. | Grey skate, | 1 | 20 | 1 | 17 | ... | ... | *Pecten opercularis*, f.; *Asterias*, sp. f., *Solaster papposa* and *Solaster endeca*, several; *Alcyonium*, sp. f.; very little in net. | At beginning — Wind E., force 5; weather, overcast; sea, strong easterly swell; tide, fully ½ flood; barometer, 30·24; transparency, 5 fathoms. |
| | | | | | Thornbackray | 1 | 18 | ... | ... | ... | ... | | |
| | | | | | Plaice, | 1 | 18½ | 1 | 17 | 11 | 15 | | |
| | | | | | " | 19 | 9½–12 | ... | ... | ... | ... | | |
| | | | | | Lemon soles, | 1 | 15 | 1 | 12 | 2 | 9½ | | |
| | W. 55·0 | 11·3 | 48·0 13½ fath. | Bottom-net. — *Boreophausia*, sp. (jun.), f.; *Tau-* | " | 4 | 8 | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 8 | 8½ | 32 | 7 | 15 | 6 | | |
| | | | | | " " | 2 | 4½ | ... | ... | ... | ... | | |

TABLE C.—Record of Observations made on Board the 'Garland' during 1891.—I. Firth of Forth—*continued.*

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Temperature. Water. Surface. | Temperature. Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c., brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station VII. 23rd June 12.35 p.m. to 2.15 p.m. —*continued.* | | | | *ria medusarum*, f.; *Atylus bispinosus*, r.; *Calanus finmarchicus*, fr.; *Sagitta*, sp. fr.; larval *Balanus*, sp. (*Cypris*-stage), fr., Ctenophora, f. | Witch soles, | 2 | 17 | ... | ... | ... | ... | | At finish—Wind E., force 5; weather, hazy; sea as before; tide, last ¼ flood; barometer, 30·24; transparency, 4½ fathoms. |
| | | | | | Flounders, | 1 | 9¾ | 2 | 8 | 1 | 6½ | | |
| | | | | | Long rough dabs, | 1 | 10½ | 26 | 8½ | 7 | 5½ | | |
| | | | | | " " | 1 | 4 | ... | ... | ... | ... | | |
| | | | | | Haddocks, | 33 | 12 | 25 | 10 | 65 | 8 | | |
| | | | | | Cod, | 1 | 13 | 1 | 10½ | ... | ... | | |
| | | | | | Whitings, | 4 | 11 | 2 | 9 | ... | ... | | |
| | | | | | Com. gurnards, | 2 | 13 | 2 | 9½ | 35 | 6½ | | |
| | | | | | " " | 1 | 4½ | ... | ... | ... | ... | | |
| | | | | | Anglers, | 1 | 16 | 1 | 15 | ... | ... | | |
| Station VIII. 24th June 9.5 a.m. to 10.50 a.m. | S.W. 58·2 | 10·6c | 46·8 21 fath. | Surface-net. — *Boreophausia*, sp. f.; *Parathemisto*, sp. f.; *Tauria medusarum*, f.; *Calanus finmarchicus*, fr.; *Dias*, sp.; *Anomalocera patersonni*, fr.; *Evadne*, sp. fr.; larval Decapod Crustacea, fr. Bottom-net. — *Boreophausia*, sp. (jun.), f.; *Erythrops*, sp. f.; *Tauria*, sp. f.; *Atylus bispinosus*, f.; *Calanus finmarchicus*, fr.; *Temora longicornis*, f.; *Anomalocera*, sp. f.; young Gastropods, f.; Lamellibranch Mollusca, fr.; larval *Balanus*. sp. (*Cypris*-stage), fr.; young starfish, several. | Plaice, | 2 | 15 | ... | ... | ... | ... | One or two *Nephrops*, sp. and *Solaster*, sp. | At beginning — Wind E.N.E., force 4; weather, overcast; sea, moderate; tide, last ¼ ebb; barometer, 30·12; transparency, 5 fathoms. At finish—Wind E.N.E., force 3; weather, hazy; sea, moderate; tide, first of flood; barometer, 30·13; transparency, 7½ fathoms. |
| | | | | | Lemon soles, | 1 | 14 | 2 | 11 | 2 | 10 | | |
| | | | | | " " | 4 | 7½–8½ | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 2 | 8½ | 5 | 7 | 9 | 6 | | |
| | | | | | Witch soles, | 1 | 16 | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 1 | 9 | 6 | 8 | 19 | 6 | | |
| | N.E. 55·7 | 11·4 | 46·1 26 fath. | | " " | 8 | 4 | ... | ... | ... | ... | | |
| | | | | | Haddocks, | 9 | 11 | 23 | 9½ | 46 | 8 | | |
| | | | | | Cod, | 1 | 16 | 1 | 17 | 1 | 13 | | |
| | | | | | Com. gurnards, | 1 | 15 | 4 | 12 | 59 | 7 | | |
| | | | | | " " | 5 | 6 | ... | ... | ... | ... | | |
| | | | | | Anglers, | 1 | 18 | 1 | 15½ | ... | ... | | |

TABLE C.—Record of Observations made on Board the 'Garland' during 1891.—I. Firth of Forth—*continued.*

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Temperature. Water. Surface. | Temperature. Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c., brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station IX. 24th June 11.50 a.m. to 1.30 p.m. | S.E. 56·5 | 11·80 | 45·2 25 fath. | Surface-net. — *Atylus swammerdami*, r.; *Calanus finmarchicus*, f.; *Temora longicornis*, f.; *Anomalocera patersonni*, f.; *Thalestris serrulatus*, several; *Sagitta*, sp. f.; Ctenophora, f.; fish ova, f. | Grey skate, | 1 | 15½ | ... | ... | ... | ... | *Nephrops*, sp. 1; *Asterias*, sp. several; *Solaster papposa*, f. | At beginning — Wind E.N.E., force 3; weather, hazy; sea, moderate; tide, first ¼ flood; barometer, 30·13; transparency, 7½ fathoms. At finish—Wind E.N.E., force 4; tide, about 3½ hours flood; barometer, 30·12; transparency, 7¾ fathoms. |
| | | | | | Starry ray, | 1 | 10 | 1 | 9½ | ... | ... | | |
| | | | | | Plaice, | 1 | 12 | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 1 | 9 | 1 | 7 | ... | ... | | |
| | | | | | Long rough dabs, | 4 | 8 | 5 | 6 | 2 | 4 | | |
| | | | | | Haddocks, | 1 | 12 | 1 | 10 | 3 | 8½–9 | | |
| | | | | | Cod, | 1 | 8 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 2 | 8 | ... | ... | ... | ... | | |
| | N.W. 58·0 | 11·4 | 46·0 24 fath. | Bottom-net. — *Tauria medusarum*, r.; *Calanus finmarchicus*, fr.; *Sagitta*, sp. f.; Ctenophora, ab.; larval *Balanus*, sp. f.; young starfish, fr. | Com. gurnards, | 1 | 14½ | 4 | 10 | 26 | 6–7 | | |
| | | | | | ,, ,, | 1 | 4 | ... | ... | ... | ... | | |
| Station I. 15th July | W. 60·0 | 13·1 | 49·9 13 fath. | Surface-net. — Net damaged, contents lost. Bottom-net. — *Tauria*, sp. f.; *Calanus finmarchicus*, ab.; *Temora longicornis*, fr.; *Sagitta*, sp. fr.; young Decapod Crustacea; larval *Balanus*, sp. c.; small Ctenophora, ab. | Plaice, | 2 | 14 | 22 | 12½ | 24 | 10½ | | At beginning — Wind E., force 4; weather, cloudy; sea, slight; tide, 1 hour ebb; barometer, 30·12; transparency, 2¾ fathoms. At finish—Wind E.S.E., force 4; weather, clear, fine; tide, nearly ½ ebb; barometer, 30·17; transparency, 3½ fathoms. |
| | | | | | ,, | 4 | 8 | ... | ... | ... | ... | | |
| | | | | | Lemon soles, | 4 | 12 | 21 | 11 | 22 | 9 | | |
| | | | | | ,, ,, | 26 | 7½ | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 3 | 9 | 25 | 7½ | 26 | 6½ | | |
| | E. 60·0 | 14·4 | 49·9 14 fath. | | ,, ,, | 3 | 3½ | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 2 | 11 | 1 | 10 | 11 | 8 | | |
| | | | | | Haddocks, | 2 | 13 | 1 | 14 | 5 | 11½ | | |
| | | | | | ,, | 4 | 9 | ... | ... | ... | ... | | |
| | | | | | Cod, | 4 | 16 | 12 | 12 | 10 | 9½ | | |
| | | | | | ,, | 14 | 8 | ... | ... | ... | ... | | |
| | | | | | Whiting, | 1 | 13 | ... | ... | ... | ... | | |
| | | | | | Com. gurnard, | 1 | 9 | ... | ... | ... | ... | | |
| | | | | | Anglers, | 1 | 25 | 2 | 17 | ... | ... | | |
| | | | | | Cat-fish, | 1 | 39 | 1 | 29 | ... | ... | | |

TABLE C.—Record of Observations made on Board the 'Garland' during 1891.—I. Firth of Forth—*continued.*

| Station, Date, and Time Trawl down. | Temperature. | | | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. | | | | | | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Air. | Water. | | | | | | | | | | | |
| | Dry Bulb. | Surface. | Bottom. | | | No. | Inches | No. | Inches | No. | Inches | | |
| Station II. 15th July 12.20 p.m. to 2.15 p.m. | W. 60·0 | 14·0 | 50·0 12½ fath. | Surface-net. — *Calanus finmarchicus*, f.; *Dias longiremis*, f.; *Temora longicornis*, f.; *Centropages*, sp. f.; *Anomalocera patersonni*, fr.; *Podon*, sp. fr.; *Evadne*, sp. f.; larval Crustacea, c.; fish ova, fr. | Thornback ray, . | 1 | 13 | ... | ... | ... | ... | | At beginning — Wind E.S.E., force 3; weather, clear, fine; sea, easterly swell, tide, about ½ ebb; barometer, 30·17; transparency, 3½ fathoms. |
| | | | | | Plaice, . . | 22 | 14½ | 25 | 12½ | 48 | 9½ | | |
| | | | | | ,, . . | 17 | 7 | ... | ... | ... | ... | | |
| | | | | | Lemon soles, . | 1 | 14 | 1 | 10 | 4 | 9 | | |
| | | | | | ,, ,, . | 8 | 7 | ... | ... | ... | ... | | |
| | | | | | Common dabs, . | 5 | 9 | 17 | 8 | 45 | 5½ | | |
| | | | | | ,, ,, . | 4 | 3½ | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 1 | 10 | 7 | 9 | 8 | 7 | | |
| | E. 60·0 | 14·7 | 52·0 10 fath. | Bottom-net.—*Tauria*, sp. f.; *Parathemisto*, sp. r.; *Calanus finmarchicus*, fr.; *Temora longicornis*, fr.; larval *Balanus*, sp., and other immature Crustacea, fr.; small Ctenophora, ab. | Haddocks, . . | 1 | 10 | 1 | 9 | ... | ... | | At finish—Wind S.E., force 4; weather, overcast; sea, slight; tide, nearly low water; barometer, 30·12; transparency, 3½ fathoms. |
| | | | | | Cod, . . . | 3 | 13 | 1 | 10 | ... | ... | | |
| | | | | | Whitings, . . | 1 | 13 | 2 | 12 | 2 | 10 | | |
| | | | | | ,, . . | 1 | 9 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, . | 1 | 15 | 6 | 13 | 7 | 10 | | |
| Station III. 18th July 10.30 a.m. to 12.40 p.m. | W. 64·0 | 58·8 | 51·2 11 fath. | Surface-net. — *Calanus finmarchicus*, f.; *Centropages*, sp. f.; *Evadne*, sp. c.; *Podon*, sp. fr.; larval Crustacea, ab.; fish ova, f. | Thornback ray, . | 1 | 24 | ... | ... | ... | ... | A considerable number of *Nephrops*, sp. and a quantity of *Pecten opercularis*. | At beginning — Wind E.S.E., force 3; weather, hazy; sea, slight; tide, last ¼ flood; barometer, 29·81; transparency, 3 fathoms. |
| | | | | | Plaice, . . | 3 | 15 | 10 | 12 | 14 | 10 | | |
| | | | | | ,, . . | 1 | 8 | ... | ... | ... | ... | | |
| | | | | | Lemon soles, . | 3 | 12 | 12 | 11 | 24 | 9 | | |
| | | | | | ,, ,, . | 8 | 7½ | ... | ... | ... | ... | | |
| | E. 61·0 | 58·1 | 49·8 13½ fath. | Bottom-net.—*Stenothoe*, sp. r.; *Calanus finmarchicus*, fr.; *Temora longicornis*, f.; small Ctenophora, c.; *Spirialis retroversus*, r. | Common dabs, . | 6 | 9 | 28 | 7½ | 6 | 5½ | | |
| | | | | | ,, ,, . | 1 | 4½ | ... | ... | ... | ... | | |
| | | | | | Flounder, . . | 1 | 7 | ... | ... | ... | ... | | At finish—Wind S.S.W., force 5; weather, hazy, showery; sea, moderate; tide, first of ebb; barometer, |
| | | | | | Long rough dabs, | 4 | 13 | 4 | 11 | 23 | 7½ | | |
| | | | | | ,, ,, | 4 | 4½ | ... | ... | ... | ... | | |
| | | | | | Haddock, . . | 1 | 8 | ... | ... | ... | ... | | |
| | | | | | Cod, . . . | 1 | 27 | 1 | 16 | 3 | 14 | | |
| | | | | | ,, . . . | 3 | 10 | ... | ... | ... | ... | | |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1891.—I. FIRTH OF FORTH—*continued.*

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Temperature. Water. Surface. | Temperature. Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c., brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION III. 18th July 10.30 a.m. to 12.40 p.m. —*continued.* | | | | | Whitings, | 1 | 13 | 24 | 12 | 7 | 10½ | | 29·83; transparency, 5 fathoms. |
| | | | | | " | 1 | 10 | ... | ... | ... | ... | | |
| | | | | | Ling, | 1 | 40 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, | 2 | 14 | 1 | 10 | 2 | 5 | | |
| | | | | | Anglers, | 2 | 27 | 1 | 16 | ... | ... | | |
| STATION IV. 17th July 10.30 a.m. to 1.30 p.m. | W. 68·0 | 57·8 | 55·3 5 fath. | Surface-net. — *Evadne*, sp. fr.; a number of *Nauplii*, and other larval forms of Crustacea; fish ova, fr. | Thornback ray, | 3 | 23 | 3 | 20 | 4 | 16 | *Pecten opercularis*, ab.; *Mytilus modiolus*, several; *Buccinum undatum*, r.; *Loligo*, sp. (juv.), fr.; *Octopus vulgaris*, r.; *Nephrops*, sp. *Portunus* (chiefly *P. depurator*), fr.; *Solaster papposa*, f.; *Echinus esculentus*, f.; *Chalina*, sp., and one or two other sponges, fr. | At beginning — Wind calm, force 0; weather, very hazy; sea, smooth; tide, near high water; barometer, 29·73; transparency, 2½ fathoms. At finish—Wind W.N.W., force 1; weather, hazy; sea, smooth; tide, nearly ½ ebb; barometer, 29·76; transparency, 4½ fathoms. |
| | | | | | Plaice, | 15 | 13 | 31 | 11 | 62 | 9½ | | |
| | | | | | " | 66 | 8 | 2 | 7 | 1 | 5 | | |
| | | | | | Lemon soles, | 5 | 18 | 5 | 10 | 11 | 9 | | |
| | | | | | " " | 11 | 7 | ... | ... | ... | ... | | |
| | E. 66·0 | 56·0 | 53·0 7 fath. | Bottom-net.—*Alteutha*, sp. r.; *Podon*, sp. fr.; *Evadne*, sp. f.; *Nauplii*, fr.; a considerable quantity of fine mud. | Common dabs, | 4 | 12½ | 20 | 9 | 15 | 6 | | |
| | | | | | " " | 2 | 5 | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 4 | 8 | 2 | 7 | ... | ... | | |
| | | | | | Cod, | 10 | 14½ | 3 | 11 | 1 | 10 | | |
| | | | | | Whiting, | 1 | 11 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, | 1 | 17 | 5 | 14 | 14 | 10 | | |
| | | | | | " " | 6 | 6½ | ... | ... | ... | ... | | |
| | | | | | Anglers, " | 3 | 17 | 5 | 14 | ... | ... | | |
| | | | | | Picked dog-fish, | 1 | 29 | ... | ... | ... | ... | | |
| STATION V. 17th July 3.35 p.m. to 5.30 p.m. | E. 63·0 | 57·1 | 48·2 22 fath. | Surface-net. — *Tauria*, sp. r.; *Calanus finmarchicus*, f.; *Centropages*, sp. fr.; *Anomalocera patersonni*, fr.; larval Crustacea, ab.; fish ova, fr. Bottom-net. — *Tauria*, | Plaice, | 7 | 17 | 18 | 15 | 8 | 13 | *Nephrops*, sp. ab.; *Asterias*, sp. f.; *Solaster papposa*, fr.; *Actinoloba*, sp. f. | At beginning — Wind E.S.E., force 2; weather, hazy; sea, smooth; tide, nearly ¾ ebb; barometer, 29·76; transparency, 6¾ fathoms. |
| | | | | | " | 1 | 10 | ... | ... | ... | ... | | |
| | | | | | Lemon sole, | 1 | 15 | 2 | 13½ | 3 | 12 | | |
| | | | | | " " | 7 | 9½ | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 1 | 11 | 5 | 8½ | 1 | 6½ | | |
| | | | | | Witch sole, | 1 | 18 | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 1 | 11 | 17 | 8½ | 16 | 6½ | | |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1891.—I. FIRTH OF FORTH—*continued.*

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Temperature. Water. Surface. | Temperature. Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c., brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION V. 17th July 3.35 p.m. to 5.30 p.m. —*continued.* | W. 61·0 | 57·0 | 49·0 27 fath. | sp. f.; *Atylus bispinosus*, r.; *Calanus finmarchicus*, f.; *Pseudocalanus elongatus*, f.; *Temora longicornis*, f.; *Centropages*, sp. fr.; *Sagitta*, sp. c.; small Ctenophora, fr. | Long rough dabs, | 6 | 4 | ... | ... | ... | ... | | At finish—Tide, first of flood; barometer, 29·77; transparency, 6 fathoms. |
| | | | | | Haddocks, . . | 1 | 23 | 3 | 16 | 3 | 14 | | |
| | | | | | " . . | 58 | 11 | 57 | 8 | ... | ... | | |
| | | | | | Cod, . . . | 1 | 27 | 1 | 24 | 2 | 15½ | | |
| | | | | | " . . . | 11 | 12 | ... | ... | ... | ... | | |
| | | | | | Whitings, . . | 1 | 15 | 3 | 11 | 6 | 9½ | | |
| | | | | | " . . | 2 | 8 | ... | ... | ... | ... | | |
| | | | | | Com. gurnard, . | 1 | 12 | 22 | 10 | 12 | 7 | | |
| STATION VI. 15th July 3.50 p.m. to 4.50 p.m. | E. 57·0 | 13·1 | 49·5 13 fath. | Surface-net. — *Calanus finmarchicus*, f.; *Temora longicornis*, f.; *Centropages*, sp. f.; *Anomalocera patersonni*, f.; young Crustacea, and young Gastropod mollusca, c.; fish ova, f.; young lump-sucker, r. | Plaice, . . | 1 | 26 | 1 | 23 | 1 | 21 | | At beginning—Wind S.E., force 3; weather, dull, showery; sea, heavy easterly swell; tide, first of flood; barometer, 30·08; transparency, 5 fathoms. |
| | | | | | " . . | 1 | 18 | 3 | 15 | 5 | 14 | | |
| | | | | | Lemon soles, . | 8 | 14 | 2 | 12 | 5 | 8 | | |
| | | | | | Common dabs, . | 2 | 8 | 5 | 7 | 3 | 6 | | |
| | | | | | Brill, . . . | 1 | 26 | ... | ... | ... | ... | | |
| | | | | | Sole, . . . | 1 | 15 | ... | ... | ... | ... | | |
| | | | | | Haddocks, . . | 2 | 12 | 3 | 11 | ... | ... | | |
| | W. 58·0 | 12·8 | 54·0 13 fath. | Bottom-net.—*Calanus finmarchicus*, f.; *Temora longicornis*, r.; *Centropages*, sp. f.; *Evadne*, sp. f.; *Caligus*, sp. r.; *Sagitta*, sp. fr.; larval and young Crustacea, fr.; a good deal of slimy mud in the net. | Whitings, . . | 4 | 12 | ... | ... | ... | ... | | At finish — Wind S.E., force 2; weather, rainy; sea, as before; tide, first ½ flood; barometer, 30·07; transparency, 5½ fathoms. |
| | | | | | Com. gurnards, . | 3 | 14 | 13 | 11 | 12 | 9 | | |
| | | | | | " " . . | 3 | 6 | ... | ... | ... | ... | | |
| | | | | | Anglers, . . | 1 | 28 | 1 | 25 | 5 | 17 | | |
| | | | | | " . . | 2 | 10 | ... | ... | ... | ... | | |
| STATION VII. 16th July 11.50 a.m. to 1.50 p.m. | W. 57·0 | 13·7 | 50·2 13½ fath. | Surface-net — *Calanus finmarchicus*, fr.; *Temora longicornis*, fr.; *Centropages*, sp. fr.; larval Decapod, Crustacea (*Portunus* ?) ab.; fish ova, f. | Grey skate, . | 1 | 22 | 1 | 16 | ... | ... | | At beginning — Wind E., force 5; weather, hazy; sea, heavy easterly swell; tide, nearly ½ ebb; |
| | | | | | Plaice, . . | 9 | 15 | 8 | 13 | 19 | 12 | | |
| | | | | | " . . | 5 | 9½ | ... | ... | ... | ... | | |
| | | | | | Lemon soles, . | 4 | 11 | 6 | 7 | ... | ... | | |
| | | | | | Common dabs, . | 12 | 8½ | 63 | 6½ | 24 | 5½ | | |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1891.—I. FIRTH OF FORTH—*continued*.

| Station, Date, and Time Trawl down. | Temperature. | | | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. | | | | | | Invertebrate Fauna, &c., brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Air. | Water. | | | | | | | | | | | |
| | Dry Bulb. | Surface. | Bottom. | | | No. | Inches | No. | Inches | No. | Inches | | |
| STATION VII. 16th July 11.50 a.m. to 1.50 p.m.—*continued*. | E. 59·0 | 12·9 | 53·0 17 fath. | Bottom-net. — *Pseudocalanus*, sp. r.; *Dias*, sp. f.; *Centropages*, sp. r.; *Podon*, sp. f.; *Sagitta*, sp. f.; larval Crustacea, f.; very little in tow-net. | Common dabs, | 3 | 4 | ... | ... | ... | ... | | barometer, 29·82; transparency, 5 fathoms. At finish—Wind variable, force 2; weather, heavy with rain; tide, last ½ ebb; barometer, 29·80; transparency, 5½ fathoms. |
| | | | | | Long rough dabs, | 20 | 8½ | 36 | 7 | 5 | 6 | | |
| | | | | | Haddocks, | 5 | 13 | 42 | 11 | 99 | 9 | | |
| | | | | | " | 4 | 7 | ... | ... | ... | ... | | |
| | | | | | Cod, | 1 | 15 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 1 | 14 | 9 | 12 | 3 | 10 | | |
| | | | | | Com. gurnards, | 3 | 14 | 5 | 12 | 4 | 10 | | |
| | | | | | " " | 4 | 6 | ... | ... | ... | ... | | |
| | | | | | Angler, | 1 | 17 | 2 | 15 | ... | ... | | |
| STATION VIII. 21st July 11.35 a.m. to 1.45 p.m. | S.W. 58·0 | 57·5 | 50·3 21½ fath. | Surface-net.—*Macropsis slabberi*, fr.; *Tauria*, sp. r.; *Centropages*, sp. fr.; *Anomalocera patersonni*, fr.; *Evadne*, sp. c.; *Podon*, sp. fr.; larval Crustacea, fr.; fish ova, f. | Grey skate, | 2 | 18 | 1 | 15 | ... | ... | *Nephrops norvegicus*, fr.; *Eupagurus bernhardus*, r.; *Solaster endeca*, f.; *Alcyonium digitatum*, f. | At beginning — Wind calm, force 0; weather, hazy, rain; sea, smooth; tide, near ½ flood; barometer, 29·89; transparency, 5 fathoms. At finish—Wind S.S.E., force 2; weather, hazy with rain; sea, slight; tide, last ¼ flood; barometer, 29·78; transparency, 5 fathoms. |
| | | | | | Starry ray, | 1 | 11 | ... | ... | ... | ... | | |
| | | | | | Plaice, | 2 | 16 | 2 | 14½ | 7 | 12 | | |
| | | | | | " | 1 | 10 | ... | ... | ... | ... | | |
| | | | | | Lemon soles, | 1 | 9½ | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 1 | 9½ | 19 | 7½ | 6 | 6 | | |
| | | | | | " " | 2 | 3½ | ... | ... | ... | ... | | |
| | N.E. 58·0 | 56·0 | 48·0 27 fath. | Bottom-net.—*Atylus bispinosus*, f.; *Tauria*, sp. r.; *Calanus*, sp. fr.; *Dias longiremis*, fr.; *Temora*, sp. fr.; *Centropages*, sp. f.; *Alteutha*, sp. r.; *Caligus rapax*, r.; *Sagitta*, sp. fr.; larval Crustacea, fr.; young fish, f. | Witch soles, | 2 | 19 | 2 | 14 | ... | ... | | |
| | | | | | Long rough dabs, | 12 | 8 | 9 | 6 | 2 | 4½ | | |
| | | | | | Haddocks, | 2 | 13 | 15 | 11½ | 13 | 9 | | |
| | | | | | " | 14 | 8 | ... | ... | ... | ... | | |
| | | | | | Cod, | 1 | 12 | 1 | 11 | 1 | 10 | | |
| | | | | | Saithe, | 1 | 14 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 2 | 13 | 1 | 12 | 2 | 10 | | |
| | | | | | " | 1 | 6½ | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, | 2 | 13 | 13 | 12 | 24 | 7 | | |
| | | | | | " " | 25 | 4½ | ... | ... | ... | ... | | |
| | | | | | Anglers, | 1 | 15 | ... | ... | ... | ... | | |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1891.—I. FIRTH OF FORTH—*continued.*

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Temperature. Water. Surface. | Temperature. Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c., brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION IX. 21st July 2.15 p.m. to 4.30 p.m. | N.W. 57·0 | 56·7 | 48·0 28 fath. | Surface-net. — *Atylus bispinosus*, r.; *Calanus finmarchicus*, f.; *Centropages*, sp. f.; *Anomalocera patersonni*, fr.; larval Echinoderms, c.; fish ova, f.; Crustacea, ab. | Lemon soles, | 2 | 12 | 2 | 9 | 1 | 7½ | ***Fusus antiquus***, 1; *Nephrops norvegicus*, several; *Actinoloba*, f. (a very little in net). | At beginning — Wind S.S.E., force 2; weather, hazy with rain; sea, slight; tide, about high water; barometer 29·79; transparency, 5 fathoms. At finish—Wind, weather, sea, as before; tide, about 2 hours ebb; barometer, 29·77; transparency, 6 fathoms. |
| | | | | | Common dabs, | 2 | 9 | 2 | 7 | 8 | 6 | | |
| | | | | | Witch sole, | 1 | 14 | 1 | 12 | 2 | 9 | | |
| | | | | | Long rough dabs, | 1 | 9 | 10 | 8 | 1 | 5½ | | |
| | | | | | ,, ,, | 1 | 4½ | ... | ... | ... | ... | | |
| | S.E. 58·0 | 56·0 | 48·0 32 fath. | Bottom-net. — *Atylus bispinosus*, f.; *Calanus*, sp. fr.; *Alteutha*, sp. r.; *Sagitta*, sp. fr.; *Tomopteris*, sp. f.; larval Crustacea, fr.; larval *Balani*, f.; larval Echinoderms, fr.; post-larval fish, f. | Haddocks, | 9 | 12 | 13 | 9½ | 14 | 8 | | |
| | | | | | Cod, | 1 | 46 | 2 | 23 | 2 | 18 | | |
| | | | | | ,, | 1 | 16 | 1 | 12 | 1 | 9 | | |
| | | | | | Whiting, | 1 | 12 | 1 | 6½ | ... | ... | | |
| | | | | | Com. gurnards, | 10 | 10 | 35 | 6½ | 1 | 4 | | |
| | | | | | Angler, | 1 | 14 | ... | ... | ... | ... | | |
| STATION I. 14th Aug. 10.22 a.m. to 12.15 p.m. | W. 56·0 | 55·3 | 53·5 13 fath. | Surface-net. — *Calanus finmarchicus*, f.; *Temora longicornis*, f.; larval Crustace, f.; fish ova, f. | Plaice, | 4 | 12 | 2 | 11 | 5 | 9 | *Pecten opercularis*, fr.; *Mytilus modiolus*, r.; *Loligo*, sp. (juv.), several; *Nephrops norvegicus*, fr.; *Asterias*, sp. r.; *Ophiothrix rosula*, com.; *Echinus esculentus*, fr.; *Actinoloba dianthus*, r. | At beginning — Wind N.E., light; weather, hazy; sea, smooth; tide, first ½ ebb; barometer, 29·80; transparency, 3 fathoms. At finish—Wind calm; weather, hazy; sea, smooth; tide, fully ½ ebb; barometer, 29·80; transparency, 7 fathoms. |
| | | | | | ,, | 1 | 8 | ... | ... | ... | ... | | |
| | | | | | Lemon soles, | 1 | 14 | 8 | 12 | 11 | 10 | | |
| | | | | | ,, ,, | 38 | 6–8 | ... | ... | ... | ... | | |
| | E. 61·0 | 55·9 | 54·0 13½ fath. | Bottom-net. — *Atylus*, sp. f.; *Tauria*, sp. r.; *Calanus*, sp. fr.; *Temora*, sp. fr.; *Dias*, sp. f.; *Centropages*, sp. f.; *Monstrilla*, sp. v. r.; *Sagitta*, sp. c.; larval Crustacea, ab.; post-larval fish, several. | Common dab, | 1 | 10 | 7 | 8 | 1 | 7 | | |
| | | | | | Long rough dabs, | 11 | 9 | 5 | 7 | 1 | 6 | | |
| | | | | | Haddock, | 1 | 12 | ... | ... | ... | ... | | |
| | | | | | Cod, | 1 | 23 | 1 | 16 | 6 | 13 | | |
| | | | | | ,, | 9 | 9–11 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 2 | 12 | 6 | 10 | ... | ... | | |
| | | | | | Com. gurnards, | 2 | 15 | 8 | 13 | 3 | 8 | | |
| | | | | | Angler, | 1 | 24 | 1 | 15 | ... | ... | | |
| | | | | | Cat-fish, | 1 | 34 | 1 | 33 | ... | ... | | |

TABLE C.—Record of Observations made on Board the 'Garland' during 1891.—I. Firth of Forth—*continued.*

| Station, Date, and Time Trawl down. | Temperature. | | | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. | | | | | | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Air. | Water. | | | | | | | | | | | |
| | Dry Bulb. | Surface. | Bottom. | | | No. | Inches | No. | Inches | No. | Inches | | |
| Station II. 14th August 12.40 p.m. to 2.30 p.m. | W. 62·0 | 55·5 | 53·8 12 fath. | Surface-net.—*Calanus finmarchicus*, f.; *Temora longicornis*, f.; *Dias*, sp. fr.; larval Crustacea, f.; fish ova, v. p. | Thornback ray, | 2 | 24 | 2 | 16 | 1 | 12 | *Nephrops norvegicus*, f.; *Asterias*, sp. f.; large Medusidæ, r. (very little in net). | At beginning — Wind calm; weather, hazy; sea, smooth; tide, about 3½ hours ebb; barometer, 29·80; transparency, 6½ fathoms. At finish—Wind S.W. by S., force 2; tide, last ¼ ebb; barometer, 29·90; transparency, 6½ fathoms. |
| | | | | | Plaice, | 1 | 18 | 32 | 14 | 40 | 12 | | |
| | | | | | ,, | 22 | 7–10 | ... | ... | ... | ... | | |
| | | | | | Lemon soles, | 4 | 13 | 10 | 11 | 7 | 9 | | |
| | | | | | ,, ,, | 9 | 6–7 | ... | ... | ... | ... | | |
| | E. 60·0 | 55·3 | 53·5 12 fath. | Bottom-net.—*Pseudocuma*, sp. r.; *Tauria*, sp. r.; *Calanus finmarchicus*, f.; *Temora longicornis*, f.; *Sagitta*, sp. r.; *Tomopteris*, r.; larval Crustacea, f. (comparatively little in tow-nets). | Common dabs, | 1 | 11 | 6 | 9½ | 11 | 8 | | |
| | | | | | ,, ,, | 106 | 6–7 | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 1 | 12 | 2 | 9 | ... | ... | | |
| | | | | | Haddocks, | 6 | 12 | 8 | 10 | 14 | 8 | | |
| | | | | | Cod, | 1 | 18 | 8 | 14 | 1 | 12 | | |
| | | | | | ,, | 8 | 9 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 1 | 13 | 1 | 11 | 2 | 8 | | |
| | | | | | Com. gurnards, | 1 | 14 | 8 | 12 | ... | ... | | |
| | | | | | Angler, | 1 | 11 | ... | ... | ... | ... | | |
| Station III. 17th August 2.0 p.m. to 4.10 p.m. | E. 56·5 | 55·3 | 53·0 8 fath. | Surface-net.—*Parathemisto*, sp. r.; *Calanus finmarchicus*, r.; *Dias longiremis*, f.; *Centropages*, sp. f.; larval Crustacea, c.; fish ova, r. | Plaice, | 1 | 12 | 1 | 9 | ... | ... | *Loligo*, sp. (juv.), fr.; *Nephrops norvegicus*, fr.; *Solaster endeca*, r.; *Actinoloba dianthus*, r.; *Aurelia*, sp. f.; Zoophytes—(*Flustra*, *Hydrallmannia*), f. | At beginning—Wind E.S.E., force 7; weather, dull; sea, rough; tide, first ¼ ebb; barometer, 29·74; transparency, 4½ fathoms. At finish — Wind S.E., force 6; tide, nearly 4 hours ebb; barometer, 29·69; transparency, 4 fathoms. |
| | | | | | Common dab, | 2 | 8 | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 1 | 8 | ... | ... | ... | ... | | |
| | | | | | Cod, | 1 | 17 | ... | ... | ... | ... | | |
| | | | | | Whiting, | 1 | 12 | 2 | 11 | 5 | 10 | | |
| | W. 58·8 | 55·2 | 58·3 7 fath. | Bottom-net. — *Metopa alderi*, r.; *Tauria*, sp. f.; *Calanus*, sp. c.; *Centropages*, sp. f.; *Sagitta*, sp. f.; small Ctenophora, c.; larval Crustacea, c.; young pipe-fish (*Syngnathus*), 1. | Com. gurnard, | 1 | 14 | 1 | 7 | ... | ... | | |
| | | | | | Angler, | 1 | 18 | ... | ... | ... | ... | | |
| Station IV. 15th August 10.20 a.m. to 12.25 p.m. | W. 60·8 | 52·0 | 56·5 4 fath. | Surface-net.—*Tauria*, sp. r.; *Dias*, sp. f.; *Temora longicornis*, f.; small Ctenophora, fr.; larval | Thornback ray, | 1 | 21 | 1 | 19 | 1 | 18 | *Pecten opercularis*, c.; *Portunus depurator*, c.; *Nephrops* | At beginning — Wind W. by N., force 5; weather, hazy; sea, moderate; |
| | | | | | Plaice, | 6 | 13 | 20 | 12 | 23 | 10 | | |
| | | | | | ,, | 49 | 8 | 18 | 7 | 1 | 5 | | |
| | | | | | Lemon soles, | 1 | 12 | 1 | 11 | 2 | 9 | | |

TABLE C.—Record of Observations made on Board the 'Garland' during 1891.—I. Firth of Forth—*continued.*

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Water. Surface. | Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c., brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station IV.<br>15th August<br>10.20 a.m. to<br>12.25 p.m.<br>—*continued.* | E. 60·0 | 56·0 | 56·4<br>6<br>fath. | Crustacea, f.; fish, ova, r.; very little in net.<br>Bottom-net. — *Metopa alderi*, r.; *Calanus finmarchicus*, c.; *Dias*, sp. f.; *Temora longicornis*, f.; *Sagitta*, sp. fr.; larval Crustacea, fr; larval Annelids, f.; *Stenorhynchus rostratus*, r.; some rubbish. | Lemon soles, . | 2 | 7 | ... | ... | ... | ... | *norvegicus*, r.; *Chalina*, sp. f.; large Medusidæ, r. | tide, first of ebb; barometer, 29·71; transparency, 2½ fathoms.<br>At finish—Wind W., force 5; sea, rough; tide, fully 2 hours ebb; barometer, 29·70; transparency, 2½ fathoms. |
| | | | | | Common dabs, . | 2 | 13 | 1 | 11 | 2 | 9 | | |
| | | | | | ,, ,, . | 4 | 6–7 | ... | ... | ... | ... | | |
| | | | | | Cod, . . | 1 | 14 | 1 | 11 | ... | ... | | |
| | | | | | Whitings, . . | 2 | 11 | 1 | 9 | ... | ... | | |
| | | | | | Ling, . . . | 1 | 12 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, . | 2 | 15 | 12 | 13 | 12 | 11 | | |
| | | | | | ,, ,, . | 2 | 6 | ... | ... | ... | ... | | |
| Station V.<br>18th August<br>2.10 p.m.<br>to 4.10 p.m. | E. 57·0<br><br>W. 60·0 | 54·2<br><br>55·8 | 51·8<br>22<br>fath.<br>51·8<br>27<br>fath. | Surface-net. —*Temora longicornis*, f.; *Dias longiremis*, f.; *Centropages*, sp. f.; *Evadne*, f.; larval Crustacea, f.; fish ova, r.<br>Bottom-net.—*Diastylis* and other Cumacea, f.; *Atylus bispinosus*, c.; *Monoculodes longimanus*, r.; *Tauria*, sp. r.; *Calanus*, sp. r.; *Temora*, sp. f.; *Centropages*, sp. f.; *Anomalocera*, sp. r.; *Caligus*, sp. r.; *Sagitta*, sp. f.; *Tomopteris*, sp., several; larval and young Crustacea, c.; young Gastropods, and Lamellibranch Mollusca, fr.; young Cephalopods, r.; young star-fish, f.; larval Annelids, fr.; post-larval fish, f. | Plaice, . . | 6 | 17 | 12 | 14 | 7 | 12 | *Octopus vulgaris* (juv.), 1; *Nephrops norvegicus*, fr.; large Medusid (*Cyanea?*), 1. | At beginning — Wind S.E., force 6; weather, very hazy; sea, rough; tide, first of ebb; barometer, 29·60; transparency, 7½ fathoms.<br>At finish—Wind E.S., force 6; tide, scarcely ½ ebb; barometer, 29·57; transparency, 7 fathoms. |
| | | | | | Common dab, . | 1 | 8 | 2 | 3½ | ... | ... | | |
| | | | | | Witch sole, . | 1 | 18 | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 1 | 9½ | 16 | 8 | 2 | 6 | | |
| | | | | | ,, ,, | 1 | 4½ | ... | ... | ... | ... | | |
| | | | | | Haddocks, . . | 1 | 15 | 6 | 14 | 16 | 11 | | |
| | | | | | ,, . . | 5 | 10 | ... | ... | ... | ... | | |
| | | | | | Cod, . . | 1 | 14 | 8 | 12 | ... | ... | | |
| | | | | | Whiting, . . | 1 | 13 | 4 | 10 | ... | ... | | |
| | | | | | Hake, . . | 1 | 15½ | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, . | 4 | 13 | 1 | 14 | 24 | 12 | | |
| | | | | | ,, ,, . | 10 | 6½ | ... | ... | ... | ... | | |
| | | | | | Angler, . . | 1 | 28 | 2 | 17 | ... | ... | | |

TABLE C.—Record of Observations made on Board the 'Garland' during 1891.—I. Firth of Forth—*continued.*

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Temperature. Water. Surface. | Temperature. Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c., brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station VI. 19th August 5.0 p.m. to 5.50 p.m. | E. 56·5 | 54·2 | 54·0 13½ fath. | Surface-net.—*Temora longicornis*, f.; *Dias longiremis*, f.; *Centropages*, sp. f.; *Anomalocera patersonni*, f.; larval Crustacea, fr. | Plaice, | 1 | 22 | 1 | 19 | 2 | 17 | *Fusus antiquus*, 1; *Pecten opercularis*, 1; *Asterias*, sp. f.; *Spatangus purpureus*, r.; large Medusidæ, r.; a considerable number of *Calisoma crenata* in dead test of a *Spatangus*. | At beginning — Wind S.E., force 4; weather, hazy; sea, easterly swell; tide, about ½ ebb; barometer, 29·55; transparency, 7 fathoms. |
| | | | | | ,, | 19 | 12-14 | ... | ... | ... | ... | | |
| | | | | | Lemon soles, | 3 | 15 | 5 | 13½ | 1 | 12 | | |
| | | | | | ,, ,, | 3 | 8-10 | ... | ... | ... | ... | | |
| | W. 57·0 | 55·1 | 54·0 14 fath. | Bottom-net. — *Atylus bispinosus*, several; *Calanus finmarchicus*, fr.; *Temora*, sp. f.; *Dias*, sp. f.; *Centropages*, sp. f.; *Sagitta*, sp. f.; *Tomopteris*, sp. f.; larval Crustacea, c.; young starfish, fr.; post-larval fish, f. | Common dabs, | 6 | 7½ | 4 | 6½ | ... | ... | | At finish—Wind S.E., force 4; tide, about 4 hours ebb; barometer, 29·56; transparency, 3 fathoms. |
| | | | | | Cod, | 1 | 15 | 2 | 14 | 1 | 12 | | |
| | | | | | Whiting, | 1 | 11 | ... | ... | ... | ... | | |
| | | | | | Com. gurnard, | 1 | 14 | 1 | 13 | 3 | 11 | | |
| | | | | | ,, ,, | 4 | 7-9 | ... | ... | ... | ... | | |
| | | | | | Anglers, | 1 | 23 | 2 | 20 | 7 | 18 | | |
| | | | | | ,, | 2 | 16 | ... | ... | ... | ... | | |
| Station VII. 17th August 10.35 a.m. to 12.30 p.m. | W. 57·0 | 54·1 | 53·9 10 fath. | Surface - net. — *Idotea marina*, r.; *Temora longicornis*, f.; *Dias longiremis*, fr.; *Sagitta*, sp. r.; larval Crustacea, fr. | Grey skate, | 1 | 19 | 1 | 16 | ... | ... | *Loligo*, sp. (juv), r.; *Eupagurus*, sp. few; *Asterias*, sp. f.; *Solaster papposa*, fr.; *Solaster endeca*, fr.; *Luidia sarsii*, r.; *Alcyonium*, sp. fr.; large Medusidæ, r.; some weed. | At beginning — Wind S.S.E., force 4; weather, dull; sea, slight; tide, near ¾ flood; barometer, 29·82; transparency, 3½ fathoms. |
| | | | | | Plaice, | 5 | 16 | 9 | 14 | 10 | 11 | | |
| | | | | | Lemon sole, | 1 | 13 | 1 | 9 | 1 | 7 | | |
| | | | | | Common dabs, | 2 | 9 | 113 | 7½ | 53 | 6 | | |
| | | | | | ,, ,, | 4 | 5 | ... | ... | ... | ... | | |
| | E. 56·0 | 54·3 | 52·5 16 fath. | Bottom - net. — *Atylus*, sp. fr.; *Tauria*, sp. r.; *Calanus finmarchicus*, f.; *Temora longicornis*, f.; *Dias*, sp. f.; *Centropages*, sp. f.; *Caligus*, sp. r.; small Ctenophora, f.; larval Crustacean, c.; larval Annelids, f.; post-larval fish, f. | Long rough dabs, | 19 | 9 | 23 | 7 | ... | ... | | At finish—Wind S.E., force 6; sea, rough; tide, first of ebb; barometer, 29·78; transparency, 5 fathoms. |
| | | | | | Haddocks, | 6 | 12 | 1 | 13 | 3 | 11 | | |
| | | | | | ,, | 45 | 9-10 | ... | ... | ... | ... | | |
| | | | | | Cod, | 1 | 13 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 2 | 13 | 4 | 11 | 1 | 10 | | |
| | | | | | Com. gurnards, | 2 | 14 | 5 | 12 | 2 | 10 | | |
| | | | | | ,, ,, | 1 | 4 | ... | ... | ... | ... | | |
| | | | | | Angler, | 1 | 17 | 1 | 15 | ... | ... | | |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1891.—I. FIRTH OF FORTH—*continued*.

| Station, Date, and Time Trawl down. | Temperature. | | | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. | | | | | | Invertebrate, Fauna, &c., brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Air. | Water. | | | | | | | | | | | |
| | Dry Bulb. | Surface. | Bottom. | | | No. | Inches | No. | Inches | No. | Inches | | |
| STATION VIII. 18th August 11.20 a.m. to 1.30 p.m. | S.W. 56·2 | 54·8 | 52·0 21 fath. | Surface-net. — *Temora longicornis*, f.; *Dias longiremis*, f.; *Centropages*, sp. f.; larval Crustacea, fr.; little in net. | Plaice, | 2 | 18 | 3 | 12 | 3 | 11 | *Loligo*, sp. (juv.), f.; *Nephrops norvegicus*, | At beginning — Wind S.E. by S., force 4; weather, dull; sea, moderate; tide, last ¼ flood; barometer, 29·59; transparency, 7 fathoms. |
| | | | | | Common dabs, | 4 | 8½ | 1 | 7 | 3 | 5 | | |
| | | | | | " " | 1 | 4 | ... | ... | ... | ... | | |
| | | | | | Witch sole, | 1 | 18 | ... | ... | ... | ... | | |
| | | | | | Flounder, | 1 | 7 | ... | ... | ... | ... | *endeca*, r. (very little in net). | |
| | N.E. 56·0 | 54·7 | * 27 fath. | Bottom-net. — *Tauria*, sp. r.; *Calanus*, sp. f.; *Temora*, sp. f.; *Dias*, sp. f.; *Centropages*, sp. f.; *Caligus*, sp., several (with *Udonella* attached); *Sagitta*, f.; larval Crustacea, fr.; post-larval fish, r. | Long rough dab, | 1 | 10 | 11 | 8 | 7 | 6 | | At finish—Wind S.E., force 6; sea, rough; tide, first of ebb; barometer, 29·60; transparency, 8 fathoms. |
| | | | | | " " | 3 | 4½ | ... | ... | ... | ... | | |
| | | | | | Haddocks, | 2 | 14 | 3 | 11 | 10 | 10 | | |
| | | | | | " | 5 | 8 | ... | ... | ... | ... | | |
| | | | | | Cod, | 1 | 13 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 3 | 12 | 6 | 10 | 3 | 8 | | |
| | | | | | Com. gurnards, | 1 | 14 | 2 | 12 | 2 | 10 | | |
| | | | | | " " | 5 | 4½ | ... | ... | ... | ... | | |
| STATION IX. 19th August 1.55 p.m. to 3.45 p.m. | S.E. 55·5 | 55·3 | 49·9 32 fath. | Surface-net.—*Calanus finmarchicus*, f.; *Temora longicornis*, f.; *Dias longiremis*, f.; *Centropages*, sp. r.; fish ova, f. | Starry ray, | 1 | 11 | ... | ... | ... | ... | *Fusus antiquus*, 1 (large); *Nephrops norvegicus*, several. | At beginning—Wind E.S.E., force 5; weather, a little hazy; sea, rough; tide, high water; barometer, 29·53; transparency, 9 fathoms. |
| | | | | | Common dabs, | 2 | 7 | ... | ... | ... | ... | | |
| | | | | | Witch soles, | 5 | 17–19 | 2 | 15 | 1 | 12 | | |
| | | | | | " " | 1 | 8 | ... | ... | ... | ... | | |
| | N.W. 59·0 | 55·0 | 49·8 31 fath. | Bottom-net. — *Atylus*, sp., several; *Tauria*, sp. f.; *Calanus*, sp. f.; *Temora*, sp. f.; *Dias*, sp. f.; *Centropages*, sp. f.; *Anomalocera patersonni*, f.; *Caligus*, sp. f.; larval Crustacea, f.; larval Annelids, f.; young starfish, f.; *Sagitta*, sp. f. | Long rough dab, | 1 | 10 | 6 | 8 | 7 | 6 | | At finish — Wind E.S.E., force 5; tide, 2 hours ebb; barometer, 29·54; transparency, 9 fathoms. |
| | | | | | Cod, | 1 | 17 | 1 | 13 | ... | ... | | |
| | | | | | Com. gurnards, | 1 | 12 | 7 | 10 | 2 | 8 | | |
| | | | | | " | 1 | 6 | ... | ... | ... | ... | | |
| | | | | | Angler, " | 1 | 33 | ... | ... | ... | ... | | |

* Boat drifting too much with the wind to get a correct observation.

TABLE C.—Record of Observations made on Board the 'Garland' during 1891.—I. Firth of Forth—*continued*.

| Station, Date, and Time Trawl down. | Temperature. | | | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. | | | | | | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Air. | Water. | | | | | | | | | | | |
| | Dry Bulb. | Surface. | Bottom. | | | No. | Inches | No. | Inches | No. | Inches | | |
| Station I.<br>19th Sept.<br>8.30 a.m.<br>to 10.35 a.m. | W. 58·0 | 54·9 | 54·7<br>10<br>fath. | | Thornback ray, | 1 | 20 | ... | ... | ... | ... | | At beginning — Wind W., force 4; weather, hazy; sea, slight; tide, nearly low water; barometer, 29·84; transparency, 1⅓ fathoms.<br>At finish—Wind W., force 5; tide, ½ flood; barometer, 29·87; transparency, 3½ fathoms. |
| | | | | | Plaice, | 6 | 14½ | 14 | 13 | 11 | 12 | | |
| | | | | | " | 4 | 10 | ... | ... | ... | ... | | |
| | | | | | Lemon soles, | 1 | 12 | 13 | 10 | 5 | 8½ | | |
| | | | | | " " | 4 | 7 | ... | ... | ... | ... | | |
| | E. 58·0 | 54·6 | 54·1<br>14<br>fath. | | Common dabs, | 4 | 9 | 18 | 8 | 6 | 7 | | |
| | | | | | " " | 1 | 5 | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 1 | 12 | 1 | 8 | 11 | 7 | | |
| | | | | | " " | 18 | 4½ | ... | ... | ... | ... | | |
| | | | | | Haddocks, | 1 | 12 | 1 | 4 | ... | ... | | |
| | | | | | Cod, | 1 | 30 | 1 | 17 | 5 | 13 | | |
| | | | | | " | 2 | 10 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 5 | 12½ | 5 | 11 | 5 | 8 | | |
| | | | | | " | 5 | 4 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, | 1 | 9 | 6 | 7 | 1 | 6 | | |
| | | | | | Angler, | 1 | 25 | .. | ... | ... | ... | | |
| Station II.<br>19th Sept.<br>11.10 a.m.<br>to 1.0 p.m. | E. 58·0 | 54·8 | 54·2<br>12<br>fath. | | Plaice, | 1 | 18 | 23 | 14½ | 22 | 12 | | At beginning — Wind W., force 5; weather, dull; showery; sea, moderate; tide, 2 hours flood; barometer, 29·85; transparency, 4 fathoms.<br>At finish—Tide, near 4 hours flood; barometer and transparency as before. |
| | | | | | " | 24 | 9 | ... | ... | .. | ... | | |
| | | | | | Lemon soles, | 1 | 13 | 3 | 11 | 1 | 7 | | |
| | | | | | Common dabs, | 1 | 11 | 11 | 9 | 39 | 8 | | |
| | | | | | " " | 24 | 5½ | ... | ... | ... | ... | | |
| | W. 59·0 | 55·0 | 54·5<br>13<br>fath. | | Long rough dabs, | 1 | 13 | 6 | 9 | 5 | 8 | | |
| | | | | | Haddocks, | 1 | 13 | 4 | 12 | 18 | 10 | | |
| | | | | | " | 1 | 9 | ... | ... | ... | ... | | |
| | | | | | Cod, | 1 | 16 | 1 | 10 | ... | ... | | |
| | | | | | Whitings, | 2 | 13 | 1 | 12 | 1 | 11 | | |
| | | | | | " | 6 | 10 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, | 1 | 14 | 1 | 13 | 9 | 12 | | |
| | | | | | " " | 3 | 7 | ... | ... | ... | ... | | |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1891.—I. FIRTH OF FORTH—*continued.*

| Station, Date, and Time Trawl down. | Temperature. | | | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. | | | | | | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Air. | Water. | | | | | | | | | | | |
| | Dry Bulb. | Surface. | Bottom. | | | No. | Inches | No. | Inches | No. | Inches | | |
| STATION III. 23rd Sept. 2.25 p.m to 4.40 p.m. | E. 60·0 | 54·0 | 53·4 7 fath. | Surface-net. — *Tauria*, sp. r.; a few young larval Crustacea and small Ctenophora. Bottom-net.—*Crangon allmanni*, f.; *Crangon fasciatus*, r.; *Crangon nanus*, several; *Erythrops*, sp. fr.; *Mysidopsis gibbosi*, f.; *Pandalus annulicornis*, f.; *Pandalus brevirostris*, f.; *Cuma goodsiri*, f.; *Mysis ornatus*, f.; *Atylus bispinosus*, several; *Tauria*, sp. f.; *Calanus*, sp. f.; post-larval fish (especially young herring), ab. | Thornback ray, | 2 | 19 | 1 | 18 | 1 | 16 | *Pecten opercularis*, ab.; *Octopus vulgaris* (juv.), 1; *Nephrops norvegicus*, f.; *Portunus depurator*, several; *Cancer pagurus*, f.; *Asterias*, sp. f. | At beginning — Wind calm, force 0; weather, dull; sea, easterly swell; tide, 2 hours flood; barometer, 30·12; transparency, 1½ fathoms. At finish—Wind N.N.E., force 1; weather, hazy; sea, smooth, easterly swell; tide, ¾ flood; transparency, 1½ fathoms. |
| | | | | | Plaice, | 2 | 15½ | 8 | 13 | 4 | 11 | | |
| | | | | | ” | 2 | 9 | ... | ... | ... | ... | | |
| | | | | | Lemon soles, | 5 | 12½ | 18 | 9 | 11 | 8 | | |
| | | | | | ” ” | 6 | 6½ | ... | ... | ... | ... | | |
| | W. 55·7 | 53·8 | 53·3 8 fath. | | Common dabs, | 1 | 8½ | 11 | 7 | 6 | 6½ | | |
| | | | | | ” ” | 5 | 5½ | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 1 | 8 | 3 | 6½ | 2 | 5½ | | |
| | | | | | Cod, | 1 | 20 | 3 | 10 | 5 | 16 | | |
| | | | | | ” | 11 | 12–14 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 6 | 11½ | 7 | 9½ | 7 | 7½ | | |
| | | | | | ” | 1 | 4 | ... | ... | ... | ... | | |
| | | | | | Brassie, | 2 | 6 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, | 1 | 8 | 3 | 5 | ... | ... | | |
| | | | | | Dragonet, | 1 | 8 | ... | ... | ... | ... | | |
| | | | | | Pogge, | 4 | 4 | ... | ... | ... | ... | | |
| | | | | | Goby, | 1 | 2 | ... | ... | ... | ... | | |
| STATION IV. 18th Sept. 11.30 a.m. to 2.40 p.m. | E. 60·0 | 55·5 | 55·2 8 fath. | | Thornback ray, | 1 | 23 | | 20 | 1 | 16 | | At beginning — Wind W., force 6; weather, cloudy, squally; sea, rough; tide, about ½ flood; barometer, 29·71; transparency, 2 fathoms. At finish—Wind W.S.W., force 7; |
| | | | | | ” ” | 1 | 14 | ... | ... | ... | ... | | |
| | | | | | Plaice, | 26 | 13½ | 29 | 11 | 58 | 9 | | |
| | | | | | ” | 41 | 7½ | ... | ... | ... | ... | | |
| | | | | | Lemon soles, | 2 | 14 | 1 | 13 | 1 | 11 | | |
| | W. 61·0 | 55·2 | 55·0 5½ fath. | | Common dabs, | 1 | 11 | 3 | 8 | 4 | 7 | | |
| | | | | | ” ” | 3 | 5 | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 1 | 8 | ... | ... | ... | ... | | |
| | | | | | Cod, | 1 | 17 | 4 | 15½ | 1 | 13 | | |
| | | | | | ” | 5 | 12 | ... | ... | ... | ... | | |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1891.—I. FIRTH OF FORTH—*continued.*

| Station, Date, and Time Trawl down. | Temperature. | | | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. | | | | | | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Air. | Water. | | | | | | | | | | | |
| | Dry Bulb. | Surface. | Bottom. | | | No. | Inches | No. | Inches | No. | Inches | | |
| STATION IV. 18th Sept. 11.30 a.m. to 2.40 p.m. —*continued.* | | | | | Whitings, | 1 | 12 | 7 | 10 | 5 | 9 | | weather, cloudy; sea, rough; tide, 1 hour ebb; barometer, 29·70; transparency, 2 fathoms. |
| | | | | | " | 1 | 4½ | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, | 8 | 15 | 14 | 14 | 5 | 11 | | |
| | | | | | " " | 21 | 8 | ... | ... | ... | ... | | |
| | | | | | Angler, | 1 | 12 | ... | ... | ... | ... | | |
| | | | | | Picked dog-fish, | 1 | 18 | 1 | 13 | ... | ... | | |
| STATION V. 1st Oct. 11.30 a.m. to 1.35 p.m. | W. 53·0 | 53·4 | 53·0 28 fath. | Surface-net.—*Dias*, sp. r.; *Atylus*, sp. r.; *Sagitta*, sp. f.; small Ctenophora, f.; (very little in net). Bottom-net. — *Atylus bispinosus*, ab.; *Calisoma crenata*, fr.; *Stenothöe*, sp. fr.; *Tauria*, sp. fr.; *Calanus finmarchicus*, fr.; *Caligus*, sp. f.; *Sagitta*, sp. v. ab. (some with young post-larval fish inside partly digested); young and larval Crustacea (Decapoda and Schizopoda), ab.; post-larval fishes, several. | Starry ray, | 1 | 7 | ... | ... | ... | ... | *Loligo*, sp. several (adult and juv.); *Nephrops norvegicus*, fr.; *Asterias*, sp. r.; *Aurelia*, sp. f. | At beginning — Wind W.S.W., force 4; weather, a little hazy; sea, slight; tide, about 4 hours flood; barometer, 29·46; transparency, 5 fathoms. At finish—Wind, weather, and sea as before; tide, near high water; barometer, 29·46; transparency, 5½ fathoms. |
| | | | | | Plaice, | 1 | 13 | ... | ... | ... | ... | | |
| | | | | | Lemon soles, | 2 | 15 | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 1 | 9 | 2 | 8 | 1 | 5 | | |
| | E. 54·7 | 53·7 | 53·1 24 fath. | | Long rough dabs, | 1 | 9 | 7 | 7 | 8 | 6 | | |
| | | | | | Haddocks, | 2 | 12 | 2 | 10 | 1 | 5 | | |
| | | | | | Cod, | 1 | 27 | 1 | 13 | ... | ... | | |
| | | | | | Whitings, | 2 | 11 | 4 | 10 | 10 | 8–9 | | |
| | | | | | " | 12 | 4½ | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, | 1 | 12 | ... | ... | ... | ... | | |
| STATION VI. 3rd Oct. 6.12 a.m. to 7.10 a.m. | W. 49·5 | 53·3 | 53·2 14 fath. | Surface-net.—*Stenothöe*, sp. r.; *Calanus finmarchicus*, fr.; *Temora longicornis*, fr.; *Sagitta*, sp. c.; larval and young Crustacea, fr.; Tadpole Ascidians, f.; young Lamellibranch and Gastropod Mollusca, fr.; small Ctenophora, fr. Bottom-net. — *Crangon* | Plaice, | 5 | 20–21 | 34 | 16–18 | 6 | 14 | *Loligo*, sp. (juv.), c.; *Octopus vulgaris*, r.; *Eupagurus bernhardus*, several; *Asterias*, sp. f.; *As-* | At beginning — Wind W.S.W., force 5; weather, dull; sea, rough; tide, fully 3 hours ebb; barometer, 29·90; transparency, 3 fathoms. |
| | | | | | " | 15 | 9–11 | ... | ... | ... | ... | | |
| | | | | | Lemon soles, | 6 | 15 | 7 | 12 | 18 | 9 | | |
| | | | | | " " | 8 | 7 | ... | ... | ... | ... | | |
| | E. 52·5 | 53·3 | 53·1 14 fath. | | Common dabs, | 1 | 12 | 2 | 9 | 16 | 8 | | |
| | | | | | " " | 5 | 6½ | ... | ... | ... | ... | | |
| | | | | | Haddocks, | 2 | 13 | 1 | 12 | 1 | 11 | | |

TABLE C.—Record of Observations made on Board the 'Garland' during 1891.—I. Firth of Forth—*continued.*

| Station, Date, and Time Trawl down. | Temperature. | | | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. | | | | | | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Air. | Water. | | | | | | | | | | | |
| | Dry Bulb. | Surface. | Bottom. | | | No. | Inches | No. | Inches | No. | Inches | | |
| Station VI. 3rd October 6.12 a.m. to 7.10 a.m. —*continued.* | | | | *nanus*, f.; ***Mysis lamorne***, fr.; *Mysis ornatus*, f.; *Mysidopsis augusta*, r.; *Calisoma crenata*, f.; *Diastylis*, sp. r.; *Monoculodes longimanus*, r.; *Atylus bispinosus*, fr.; *Calanus finmarchicus*, c.; *Temora longicornis*, f.; *Caligus rapax*, several; young and larval Crustacea, c.; young Lamellibranch and Gastropod Mollusca, c.; *Sagitta*, ab.; small Ctenophora, fr.; post-larval fish, f. | Cod, | 3 | 19–20 | 4 | 17 | 3 | 15 | *tropecten irregularis*, r.; *Aurelia*, sp.; and other large Medusidæ, f. | At finish—Wind W.S.W., force 6; weather, dull; sea, rough; tide, fully 4 hours ebb; barometer, 29·91; transparency, 4 fathoms. |
| | | | | | " | 1 | 12 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 5 | 12 | 8 | 10 | 12 | 8 | | |
| | | | | | " | 1 | 5 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, | 2 | 13 | 3 | 12 | 5 | 8 | | |
| | | | | | " " | 14 | 6 | ... | ... | ... | ... | | |
| | | | | | Angler, " | 1 | 13 | ... | ... | ... | ... | | |
| Station VII. 23rd Sept. 12.15 p.m. to 1.45 p.m. | E. 56·0 | 53·9 | 53·4 17 fath. | Surface-net.—A young *Cyclopterus* and a few larval Crustacea; myriads of Embryo medusidæ (*Cyanea* ?). Bottom-net.—*Erythrops göesii*, c.; *Ampelisca*, sp. f.; *Stenothöe marina*, f.; *Atylus bispinosus*, f.; *Monoculodes longimanus*, f.; *Tauria*, sp. f.; *Calanus finmarchicus*, f.; *Sagitta*, sp. c.; larval and young Crustacea, ab.; several young fish (*Gobius*, &c.). | Grey skate, | 1 | 19 | 1 | 17 | 1 | 16 | *Loligo vulgaris* (juv.), several; *Octopus*, sp. (juv.), 1; *Cancer pagurus*, several; *Eupagurus bernhardus*, f.; *Echinus esculentus*, r.; *Astropecten irregularis*, r.; *Luidia sarsii*, r.; Zoophytes (*Flustra*), r.; *Alcyonium digitatum*, r.; weed, f. | At beginning — Wind S.E., force 4; weather, dull; sea, easterly swell; tide, about low water; barometer, 30·13; transparency, 2 fathoms. At finish—Wind calm; weather and sea as before; tide, first ½ flood; barometer, 30·12; transparency, 2½ fathoms. |
| | | | | | " " | 1 | 14 | ... | ... | ... | ... | | |
| | | | | | Plaice, | 1 | 19 | 1 | 16 | 5 | 14 | | |
| | | | | | " | 6 | 10–12 | ... | ... | ... | ... | | |
| | | | | | Lemon soles, | 1 | 15 | 1 | 13 | 1 | 12 | | |
| | W. 57·0 | 54·0 | 53·2 11 fath. | | " " | 1 | 10 | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 2 | 9 | 29 | 7½ | 7 | 6 | | |
| | | | | | " " | 6 | 4½ | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 1 | 10 | 6 | 7 | 4 | 5½ | | |
| | | | | | Haddocks, | 6 | 13½ | 28 | 11½ | 14 | 10 | | |
| | | | | | " | 19 | 8½ | ... | ... | ... | ... | | |
| | | | | | Cod, | 1 | 15 | 1 | 13 | 6 | 11 | | |
| | | | | | " | 3 | 9 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 11 | 11 | 21 | 10 | 39 | 8½ | | |
| | | | | | " | 8 | 7 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, | 1 | 15 | 1 | 12 | 2 | 10 | | |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1891.—I. FIRTH OF FORTH—*continued.*

| Station, Date, and Time Trawl down. | Temperature. | | | Surface Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. | | | | | | Invertebrate Fauna, &c., brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Air. | Water. | | | | | | | | | | | |
| | Dry Bulb. | Surface. | Bottom. | | | No. | Inches | No. | Inches | No. | Inches | | |
| STATION VII. 23rd Sept. 12.15 p.m. to 1.45 p.m. —*continued.* | | | | | Com. gurnards, . | 25 | 5½–7½ | ... | ... | ... | ... | | |
| | | | | | Angler, . . | 1 | 18 | ... | ... | ... | ... | | |
| | | | | | Dragonet, . . | 1 | 9 | 1 | 7½ | ... | ... | | |
| | | | | | Brassie (*Labrus macalatus* ?), . | 1 | 8 | ... | ... | ... | ... | | |
| STATION VIII. 24th Sept. 10.45 a.m. to 12.30 p.m. | S.W. 52·0 | 53·7 | 53·2 21½ fath. | Surface-net. — *Dias longiremis*, f.; *Temora longicornis*, f.; *Centropages*, sp. r.; *Evadne*, sp. r.; larval Crustacea, f. | Plaice, . . | 1 | 17 | ... | ... | ... | ... | *Cancer pagurus*, r.; *Nephrops norvegicus*, ab.; *Aurelia*, sp. f.; *Loligo vulgaris*, r. | At beginning—Wind S.S.E., force 3; weather, dull, rain; sea, moderate; tide, 4 hours ebb; barometer, 29·97; transparency, 3 fathoms. |
| | | | | | Common dabs, . | 1 | 12 | 1 | 9 | 10 | 7 | | |
| | | | | | " " . | 3 | 5 | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 1 | 9 | 9 | 8 | 14 | 6 | | |
| | | | | | " " | 8 | 4½ | ... | ... | ... | ... | | |
| | N.E. 52·8 | 53·8 | 53·1 27 fath. | Bottom-net.—*Mysis*, sp. r.; *Pseudocuma*, sp. f.; *Atylus bispinosus*, fr.; *Calisoma crenata*, f.; *Calanus finmarchicus*, f.; *Temora longicornis*, fr.; *Sagitta*, sp. f.; larval and young Crustacea, fr. | Haddocks, . . | 1 | 14 | 1 | 15 | 3 | 10–13 | | At finish — Wind S.S.E., force 5; weather, dull, fair; sea, moderate; tide, about low water; barometer, 29·95; transparency, 3½ fathoms. |
| | | | | | " . . | 2 | 5 | ... | ... | ... | ... | | |
| | | | | | Cod, . . . | 1 | 20 | 1 | 16 | 1 | 14 | | |
| | | | | | " . . . | 1 | 11 | ... | ... | ... | ... | | |
| | | | | | Whitings, . . | 1 | 10 | 1 | 9 | 7 | 7½ | | |
| | | | | | " . . | 5 | 4 | ... | ... | ... | ... | | |
| STATION IX. 24th Sept. 1.20 p.m to 3.10 p.m. | S.E. 53·8 | 53·5 | 53·0 32 fath. | Surface-net. — *Temora longicornis*, fr.; larval Crustacea, fr.; some weed. Bottom-net.—*Pseudocuma*, sp. f.; *Atylus bispinosus*, fr.; *Calisoma*, sp. f.; *Caprella*, sp. f.; *Calanus finmarchicus*, f.; *Dias longiremis*, f.; *Temora longicornis*, fr.; *Caligus*, sp. several; *Sagitta*, sp. ab.; small Ctenophora, f.; larval and young Crustacea, fr.; post-larval fish, f. | Plaice, . . | 1 | 19 | 1 | 17 | 1 | 15 | *Loligo vulgaris* (juv.), several; *Octopus vulgaris*, r.; *Nephrops norvegicus*, ab.; (several with ova). | At beginning—Wind S.S.E., force 6; weather, dull; sea, rough; tide, first of flood; barometer, 29·94; transparency, 3½ fathoms. At finish—Wind S.W., force 6; weather, clear; sea, rough; tide, fully 2 hours flood; barometer, 29·92; transparency, 3¾ fathoms. |
| | | | | | " . . | 1 | 14 | ... | ... | ... | ... | | |
| | | | | | Lemon soles, . | 1 | 16 | 1 | 7 | ... | ... | | |
| | | | | | Common dabs, . | 2 | 11 | 7 | 8 | 7 | 6 | | |
| | | | | | " " . | 13 | 5 | ... | ... | ... | ... | | |
| | N.W. 58·8 | 53·9 | 53·0 30 fath. | | Sail fluke, . | 1 | 16 | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 2 | 10 | 16 | 8 | 34 | 6 | | |
| | | | | | " " | 14 | 4½–5 | ... | ... | ... | ... | | |
| | | | | | Haddock, . . | 1 | 10 | ... | ... | ... | ... | | |
| | | | | | Cod, . . . | 1 | 19 | 8 | 10½ | ... | ... | | |
| | | | | | Com. gurnards, . | 1 | 10 | 2 | 7 | 2 | 6 | | |
| | | | | | Angler, . . | 1 | 26 | ... | ... | ... | ... | | |

TABLE C.—Record of Observations made on Board the 'Garland' during 1891.—I. Firth of Forth—*continued.*

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Temperature. Water. Surface. | Temperature. Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station I. 24th Oct. 10.25 a.m. to 12.20 p.m. | W. 51·0 | 51·0 | 51·3 11 faths. | Surface-net. — Small Ctenophora, f.; larval Crustacea, f. (very little in net). Bottom-net.—*Macropsis slabberi*, f.; *Mysis*, sp. f.; *Calisoma crenata*, f.; *Parathemisto*, sp. f.; *Calanus finmarchicus*, c.; *Sagitta*, sp. v. ab.; small Ctenophora, fr.; larval and young Crustacea, fr.; young fish, f. | Thornback ray, | 1 | 16 | ... | ... | ... | ... | *Pecten opercularis*, fr.; *Loligo vulgaris*, f.; *Octopus vulgaris* (juv.), 3; *Asterias*, sp. f.; *Nephrops norvegicus*, f.; *Ophiothrix rosula*, f.; *Actinoloba dianthus*, r.; *Alcyonium*, sp. r. | At beginning — Wind W., force 3; weather, thick fog; sea, slight; tide, 3½ hours ebb; barometer, 29·67; transparency, 2 fathoms. At finish—Wind W.N.W., force 2; weather, very hazy; sea, slight; tide, 5 hours ebb; barometer, 29·72; transparency, 2½ fathoms. |
| | | | | | Plaice, | 2 | 15 | 6 | 14 | 12 | 12 | | |
| | | | | | Lemon soles, | 2 | 15 | 3 | 14 | 5 | 13 | | |
| | | | | | " " | 15 | 11 | 18 | 8 | 11 | 6 | | |
| | E. 55·0 | 50·8 | 51·3 15½ faths. | | Common dabs, | 3 | 10 | 13 | 9 | 18 | 7 | | |
| | | | | | " " | 17 | 6 | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 1 | 11 | 12 | 8 | 18 | 6 | | |
| | | | | | " " | 15 | 4½ | ... | ... | ... | ... | | |
| | | | | | Cod, | 1 | 20 | 2 | 18 | 4 | 14 | | |
| | | | | | " | 1 | 12 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 3 | 15 | 10 | 14 | 36 | 10–12 | | |
| | | | | | " | 39 | 5½–8 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, | 3 | 11 | 2 | 8 | 4 | 6 | | |
| | | | | | Anglers, | 2 | 29 | 1 | 27 | 1 | 17 | | |
| | | | | | " | 1 | 16 | ... | ... | ... | ... | | |
| Station II. 23rd Oct. 1.45 p.m. to 3.10 p.m. | E. 53·0 | 51·1 | 51·3 14 fath. | Surface-net. — A few *Dias*, sp., and a small quantity of mud in suspension in the water. Bottom-net.—*Calisoma crenata*, r.; *Calanus finmarchicus*, fr.; *Temora longicornis*, f.; *Sagitta*, sp. c.; *Tomopteris*, f.; young Crustacea, f. | Thornback ray, | 1 | 13 | ... | ... | ... | ... | *Asterias*, sp. f.; *Ophiothrix rosula*, f.; *Alcyonium*, sp. f.; *Aurelia aurita*, f. | At beginning — Wind W., force 1; weather, very hazy; sea, smooth; tide, 1 hour flood; barometer, 29·33; transparency, 3½ fathoms. At finish—Wind W.N.W., force 2; tide, 2½ hours flood; barometer, 29·35; transparency, 3½ fathoms. |
| | | | | | Plaice, | 3 | 15 | 21 | 14 | 33 | 12 | | |
| | | | | | " | 20 | 8½–10 | ... | ... | ... | ... | | |
| | | | | | Lemon soles, | 1 | 11 | 1 | 9 | ... | ... | | |
| | | | | | Common dabs, | 36 | 8½ | 70 | 7 | 50 | 5–5½ | | |
| | W. 54·0 | 51·0 | 51·2 13½ fath. | | Long rough dabs, | 8 | 10 | 1 | 12 | 19 | 8 | | |
| | | | | | " " | 14 | 5–5½ | ... | ... | ... | ... | | |
| | | | | | Haddocks, | 1 | 11 | 3 | 10 | 1 | 8 | | |
| | | | | | " | 8 | 5 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 1 | 15 | 3 | 12 | 12 | 11 | | |
| | | | | | " | 3 | 9 | 11 | 7½ | 46 | 5–5½ | | |
| | | | | | Com. gurnards, | 1 | 15 | 1 | 12 | 1 | 6½ | | |
| | | | | | " " | 1 | 5 | ... | ... | ... | ... | | |
| | | | | | John Dory, | 1 | 16 | ... | ... | ... | ... | | |

TABLE C.—Record of Observations made on Board the 'Garland' during 1891.—I. Firth of Forth—*continued.*

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulbs. | Temperature. Water. Surface. | Temperature. Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station III. 19th Oct. 1.0 p.m. to 3.0 p.m. | E. 48·0 | 51·6 | 51·6 12½ fath. | Surface-net. — Larval Crustacea, fr. Bottom-net.—*Macropsis slabberi*, f.; *Leptomysis gracilis*, r.; *Siriella*, sp. r.; Boreophausidæ (*Thysanöessa*?) several; *Ampelisca*, sp. r.; *Parathemisto*, sp. f.; *Calanus finmarchicus*, fr.; *Caligus rapax*, f.; *Sagitta*, sp. v. ab.; *Tomopteris*, sp. r.; small Ctenophora, fr.; larval Crustacea, fr.; post-larval and young fishes, fr. | Thornback ray, | 1 | 17 | 1 | 13 | 1 | 12 | *Pecten opercularis*, ab.; *Loligo*, sp. several; *Octopus vulgaris*, 1; *Portunus depurator*, several; *Nephrops norvegicus*, fr.; *Asterias*, sp. f.; *Solaster papposa*, fr.; *Echinus esculentus*, f. | At beginning — Wind W. by N., force 6; weather, moderately clear; sea, rough; tide, 3½ hours flood; barometer, 29·22; transparency, 3 fathoms. At finish—Wind, weather, and sea as before; tide, 5½ hours flood; barometer, 29·23; transparency, 2 fathoms. |
| | | | | | Plaice, | 2 | 13 | 4 | 11 | 5 | 8 | | |
| | | | | | Lemon soles, | 1 | 14 | 5 | 12 | 15 | 10 | | |
| | | | | | ,, ,, | 14 | 7 | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 3 | 12 | 10 | 11 | 16 | 9 | | |
| | W. 51·0 | 51·8 | 51·7 9 fath. | | ,, ,, | 56 | 5–6 | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 1 | 10 | 8 | 9 | 9 | 6½ | | |
| | | | | | ,, ,, | 5 | 5 | ... | ... | ... | ... | | |
| | | | | | Haddocks, | 3 | 5 | ... | ... | ... | ... | | |
| | | | | | Cod, | 1 | 38 | 1 | 27 | 4 | 16–17 | | |
| | | | | | ,, | 11 | 11–13 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 3 | 15 | 3 | 13 | 117 | 11–12 | | |
| | | | | | ,, | 77 | 7–9 | ... | ... | ... | ... | | |
| | | | | | Hake, | 1 | 11 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, | 3 | 15 | 2 | 13 | 7 | 11 | | |
| | | | | | ,, ,, | 19 | 6–8 | ... | ... | ... | ... | | |
| | | | | | Angler, | 1 | 27 | 2 | 19 | 2 | 11 | | |
| Station IV. 16th Oct. 11.40 a.m. to 2.30 p.m. | W. 50·5 | 51·0 | 50·8 5 fath. | Surface-net. — *Macropsis slabberi*, fr.; *Calanus finmarchicus*, r.; *Dias*, sp. f.; some floating débris (leaves of trees, &c). Bottom-net.—*Calanus finmarchicus*, fr.; *Dias*, sp. f.; *Caligus rapax*, fr.; *Sagitta*, sp. fr.; small Ctenophora, fr.; 1 young pipe fish (*Syngnathus acus*), very little, comparatively, in either surface or bottom tow-nets. | Plaice, | 1 | 16 | 3 | 14 | 5 | 12 | *Pecten opercularis*, fr.; *Portunus holsatus*, f.; *Nephrops norvegicus*, r.; *Asterias*, sp. f.; *Aurelia aurita*, several. | At beginning—Wind S., force 6; weather, cloudy; sea, rough; tide, barometer, 29·11; transparency, 1¼ fathoms. At finish—Wind S. force 7; weather, sea, tide, as before; barometer, 29·08; transparency, 2 fathoms. |
| | | | | | ,, | 7 | 9–10 | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 2 | 8 | 1 | 5 | ... | ... | | |
| | | | | | Long rough dabs, | 1 | 9 | 1 | 7½ | ... | ... | | |
| | E. 50·5 | 51·0 | 51·5 6¼ fath. | | Whitings, | 1 | 10 | 2 | 8½ | 5 | 7 | | |
| | | | | | ,, | 6 | 5½ | 7 | 4½ | 2 | 3½ | | |
| | | | | | Com. gurnard, | 1 | 14½ | ... | ... | ... | ... | | |
| | | | | | Sprats, | 32 | 5½ | 16 | 3½–4½ | ... | ... | | |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1891.—I. FIRTH OF FORTH—*continued.*

| Station, Date, and Time Trawl down. | Temperature. | | | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. | | | | | | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Air. | Water. | | | | | | | | | | | |
| | Dry Bulb. | Surface. | Bottom. | | | No. | Inches | No. | Inches | No. | Inches | | |
| STATION V. 22nd Oct. 12.45 p.m. to 3.0 p.m. | E. 56·0 | 51·8 | 51·4 19 fath. | Surface-nets.—*Calanus finmarchicus*, f.; *Pseudocalanus*, sp. f.; *Dias*, sp. f.; small Ctenophora, f.; *Sagitta*, sp. f. | Thornback ray, | 1 | 14 | ... | ... | ... | ... | *Loligo*, sp. several (old and young); *Octopus vulgaris*, 1 half grown; *Nephrops norvegicus*, ab.; *Asterias*, sp. r. | At beginning — Wind S.W., force 1; weather, moderately clear; sea, strong easterly swell; tide, ¼ hour flood; barometer, 29·06; transparency, 5½ fathoms. At finish—Wind W., force 2; weather, hazy; sea, as before; tide, 3½ hours flood; barometer, 29·06; transparency, 5½ fathoms. |
| | | | | | Plaice, | 4 | 16 | 6 | 15 | 7 | 13 | | |
| | | | | | „ | 1 | 12 | ... | ... | ... | ... | | |
| | | | | | Lemon soles, | 1 | 15 | 1 | 14 | 1 | 5½ | | |
| | | | | | Common dabs, | 2 | 10 | 2 | 8 | 2 | 7 | | |
| | W. 53·0 | 51·4 | 51·1 27 fath. | Bottom-net.—*Calisoma crenata*, several; *Calanus finmarchicus*, f.; *Sagitta*, sp. v. ab.; small Ctenophora, f.; young Crustacea, f. | „ „ | 5 | 5½ | ... | ... | ... | ... | | |
| | | | | | Witch soles, | 1 | 15 | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 1 | 12 | 6 | 10–11 | 22 | 8 | | |
| | | | | | „ „ | 59 | 5–6 | ... | ... | ... | ... | | |
| | | | | | Haddocks, | 1 | 21 | 1 | 16 | 9 | 12–13 | | |
| | | | | | „ | 10 | 6–10 | ... | ... | ... | ... | | |
| | | | | | Cod, | 1 | 32 | 1 | 22 | 6 | 15–18 | | |
| | | | | | „ | 3 | 10–12 | ... | ... | ... | ... | | |
| | | | | | Brassie, | 2 | 6 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 1 | 16 | 10 | 12–13 | 16 | 8–10 | | |
| | | | | | „ | 24 | 4½–5½ | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, | 1 | 13 | 3 | 12 | 1 | 5 | | |
| STATION VI. 22nd Oct. 3.35 p.m. to 4.25 p.m. | E. 52·0 | 51·5 | 51·0 16 faths. | Surface-net.—*Eurydice pulchra*, 1 sp.; *Calanus finmarchicus*, f.; *Sagitta*, sp. f.; small Ctenophora, fr. | Plaice, | 2 | 27 | 1 | 24 | 1 | 20 | One large *Fusus antiquus* and some weed. | At beginning—Wind W., force 4; weather, hazy; sea, moderate; tide, 4 hours flood; barometer, 29·06; transparency, 5 fathoms. At finish — Wind N.W., force 2; weather and sea as before; tide, 5 hours flood; barometer, 29·07; transparency, 4½ fathoms. |
| | | | | | „ | 9 | 18 | 31 | 16 | 32 | 14 | | |
| | | | | | „ | 10 | 12 | 6 | 10 | ... | ... | | |
| | | | | | Lemon soles, | 1 | 16 | 1 | 14 | 2 | 12 | | |
| | W. 51·0 | 51·3 | 51·0 13 faths. | Bottom-net.—*Calisoma crenata*, f.; *Atylus bispinosus*, f.; *Calanus finmarchicus*, fr.; *Caligus rapax*, r.; *Sagitta*, sp. fr.; *Tomopteris*, r.; small Ctenophora, f.; larval Crustacea, f. | „ „ | 8 | 8–10 | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 5 | 9 | 10 | 8 | 11 | 6–7 | | |
| | | | | | „ „ | 1 | 4½ | ... | ... | ... | ... | | |
| | | | | | Brill, | 2 | 13 | ... | ... | ... | ... | | |
| | | | | | Cod, | 2 | 17 | 1 | 14 | ... | ... | | |
| | | | | | Whitings, | 1 | 18 | 1 | 12 | ... | ... | | |
| | | | | | Com. gurnards, | 2 | 14 | 1 | 15 | 8 | 11 | | |

TABLE C.—Record of Observations made on Board the 'Garland' during 1891.—I. Firth of Forth—*continued.*

| Station, Date, and Time Trawl down. | Temperature. | | | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. | | | | | | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Air. | Water. | | | | | | | | | | | |
| | Dry Bulb. | Surface. | Bottom. | | | No. | Inches | No. | Inches | No. | Inches | | |
| STATION VII. 21st Oct. 12.25 p.m. to 2.20 p.m. | E. 52·5 | 51·1 | 51·2 15½ fath. | Surface-net.—*Hyperia*, sp. f.; *Idotea linearis*, r.; *Sagitta*, sp. f.; small Ctenophora, f. | Thornback ray, | 1 | 9 | ... | ... | ... | ... | *Cancer pagurus*, several (mostly juv.); *Portunus holsatus*, f.; *Eupagurus bernhardus*, several large specimens; *Asterias*, sp. f.; *Solaster endeca*, fr.; *Solaster papposa*, f.; *Luidia sarsii*, f.; *Echinus esculentus*, r.; some weed. | At beginning — Wind S.E., force 6; weather, dull; sea, rough; tide, 1¾ hours flood; barometer, 29·03; transparency, 3 fathoms. At finish—Wind S.S.W., force 4; weather, moderately clear; sea, moderate; tide, 3½ hours flood; barometer, 29·02; transparency, 2¾ fathoms. |
| | | | | | Plaice, | 1 | 16 | 4 | 15 | 5 | 12 | | |
| | | | | | Common dabs, | 1 | 10 | 4 | 9 | 78 | 8 | | |
| | | | | | " " | 139 | 5–6½ | ... | ... | ... | ... | | |
| | W. 54·0 | 51·0 | 50·9 12 fath. | Bottom-net.—*Calisoma crenata*, r.; *Atylus bispinosus*, r.; *Sagitta*, sp. ab.; young and larval Crustacea, f. | Witch soles, | 1 | 19 | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 1 | 12 | 17 | 8½ | 41 | 6½ | | |
| | | | | | " " | 15 | 4½–5½ | ... | ... | ... | ... | | |
| | | | | | Turbot, | 1 | 12 | ... | ... | ... | ... | | |
| | | | | | Haddocks, | 2 | 12 | 2 | 11 | 5 | 9 | | |
| | | | | | " | 2 | 5 | ... | ... | ... | ... | | |
| | | | | | Cod, | 1 | 10 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 3 | 12 | 12 | 11 | 50 | 9½ | | |
| | | | | | " | 47 | 8 | 8 | 4½ | ... | ... | | |
| | | | | | Com. gurnards, | 1 | 15 | 3 | 8 | 30 | 5 | | |
| | | | | | " " | 2 | 3 | ... | ... | ... | ... | | |
| | | | | | Dragonet, | 1 | 7 | ... | ... | ... | ... | | |
| STATION VIII. 30th Oct. 11.30 a.m. to 1.10 p.m. | S.W. 53·0 | 50·0 | 50·8 21½ faths. | Surface-net.—*Hyperia*, sp. f.; *Anomalocera patersonni*, f.; *Sagitta*, sp. f.; small Ctenophora, c.; young Crustacea (*Portunus?*), f.; young fish (*Motella*), r. | Grey skate, | 1 | 16 | 1 | 12 | ... | ... | *Loligo*, sp. f.; *Octopus*, sp. 1; *Nephrops norvegicus*, fr.; *Solaster endeca*, f.; *Asterias*, sp. several; *Aurelia*, sp. f. | At beginning — Wind W., force 2; weather, very hazy; sea, slight; tide, 4½ hours flood; barometer, 30·56; transparency, 5 fathoms. At finish—Wind N.W., force 1; weather and sea as before; tide, high water; barometer, 30·55; transparency, 9 fathoms. |
| | | | | | Starry ray, | 1 | 11 | ... | ... | ... | ... | | |
| | | | | | Thornback ray, | 1 | 16 | 1 | 13 | ... | ... | | |
| | | | | | Plaice, | 2 | 17 | 3 | 14 | 3 | 13 | | |
| | | | | | Common dabs, | 1 | 8 | 12 | 7 | 8 | 5½ | | |
| | | | | | " " | 11 | 4½ | ... | ... | ... | ... | | |
| | | | | | Witch soles, | 1 | 17 | ... | ... | ... | ... | | |
| | N.E. 49·0 | 51·0 | 51·1 26½ faths. | Bottom-net.—*Calisoma*, sp. f.; *Atylus*, sp. f.; *Calanus finmarchicus*, c.; *Sagitta*, sp. ab.; *Tomopteris*, f.; young fish (herring?), r.; small Ctenophora, f. | Long rough dabs, | 13 | 8 | 12 | 7 | 37 | 6 | | |
| | | | | | " " | 11 | 4½ | ... | ... | ... | ... | | |
| | | | | | Haddocks, | 1 | 13 | 1 | 14 | 3 | 6 | | |
| | | | | | Whitings, | 1 | 10 | 2 | 5 | ... | ... | | |
| | | | | | Hake, | 1 | 10 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, | 5 | 11 | 7 | 6 | ... | ... | | |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1891.—I. FIRTH OF FORTH—*continued.*

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Temperature. Water. Surface. | Temperature. Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION IX. 30th Oct. 1.30 p.m to 3.30 p.m. | N.W. 49·0 | 50·9 | 51·8 28 fath. | Surface-net. — *Hyperia*, sp. f.; *Sagitta*, sp. f.; small Ctenophora, ab.; young fish (*Motella*), 1. Bottom-net. — *Calisoma*, sp. fr.; *Atylus*, sp. f.; *Calanus finmarchicus*, fr.; *Temora longicornis*, f.; *Sagitta*, sp. ab.; *Tomopteris*, sp. fr.; small Ctenophora, f. | Thornback ray, . | 1 | 24 | 1 | 12 | ... | ... | *Loligo*, sp. several (juv.); *Tritonia hombergi*, 1; *Nephrops norvegicus*, fr.; *Cancer pagurus*, f. | At beginning—Wind E.N.E., force 2; weather, very hazy; sea, smooth; tide, ½ hour ebb; barometer, 30·55; transparency, 9 fathoms. At finish — Wind variable, light; weather and sea as before; tide, 2½ hours ebb; barometer, 30·56; transparency, 9½ fathoms. |
| | | | | | Plaice, . . | 1 | 18 | 1 | 17 | 1 | 15 | | |
| | | | | | „ . . | 9 | 12-13 | ... | ... | ... | ... | | |
| | | | | | Lemon soles, . | 1 | 14 | ... | ... | ... | ... | | |
| | S.E. 49·0 | 51·0 | 51·0 31 fath. | | Common dabs, . | 1 | 10 | 12 | 8 | 53 | 6½ | | |
| | | | | | „ „ . | 40 | 4-5½ | ... | ... | ... | ... | | |
| | | | | | Witch soles, . | 1 | 18 | 3 | 13 | 1 | 11 | | |
| | | | | | Long rough dabs, | 2 | 10 | 5 | 8½ | 33 | 7 | | |
| | | | | | „ „ . | 38 | 5-6 | ... | ... | ... | ... | | |
| | | | | | Haddocks, . . | 4 | 6 | ... | ... | ... | ... | | |
| | | | | | Cod, . . . | 1 | 14 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, . | 1 | 14 | 3 | 12 | 1 | 10 | | |
| | | | | | „ „ . | 3 | 7-9 | ... | ... | ... | ... | | |
| STATION I. 25th Nov. 10.23 a.m. to 12.28 p.m. | W. 41·5 | 45·8 | 48·0 11½ fath. | Surface-net. — *Parathemisto*, sp. fr.; Ctenophora, f.; *Tomopteris*, sp. r.; young Crustacea, fr.; Infusoria, fr. Bottom-net. — *Parathemisto*, sp. f.; *Calanus finmarchicus*, ab.; *Sagitta*, sp. ab.; *Tomopteris*, sp. f.; Ctenophora, f.; young fish, r. | Thornback ray, . | 2 | 13 | ... | ... | ... | ... | *Pecten opercularis*, fr.; *Nephrops norvegicus*, r.; *Asterias*, sp. f.; *Solaster endeca*, f.; *Solaster papposa*, r.; *Echinus esculentus*, f. | At beginning — Wind S., force 4; weather, very hazy; sea, moderate; tide, high water; barometer, 29·55; transparency, 2 fathoms. At finish—Wind S.S.W., force 5; tide, 2 hours ebb; barometer, 29·55; transparency, 4½ fathoms. |
| | | | | | Plaice, . . | 1 | 14 | 2 | 12 | 3 | 11 | | |
| | | | | | Lemon soles, . | 3 | 12 | 6 | 10½ | 8 | 9 | | |
| | | | | | „ „ . | 2 | 7 | ... | ... | ... | ... | | |
| | | | | | Common dabs, . | 1 | 10 | 16 | 8½ | 9 | 6 | | |
| | E. 42·0 | 47·0 | 48·1 17½ fath. | | „ „ . | 11 | 5 | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 1 | 9 | 1 | 8 | 2 | 7 | | |
| | | | | | „ „ . | 3 | 5 | ... | ... | ... | ... | | |
| | | | | | Cod, . . . | 1 | 23 | 2 | 20 | 6 | 19 | | |
| | | | | | „ . . . | 3 | 15 | ... | ... | ... | ... | | |
| | | | | | Whitings, . . | 3 | 15 | 6 | 12½ | 7 | 9 | | |
| | | | | | „ . . . | 15 | 4½-6 | ... | ... | ... | ... | | |
| | | | | | Anglers, . . | 1 | 26 | 1 | 22 | 1 | 16 | | |

TABLE C.—Record of Observations made on Board the 'Garland' during 1891.—I. Firth of Forth—*continued.*

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Temperature. Water. Surface. | Temperature. Water. Bottom | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station II. 21st Nov. 11.15 a.m to 12.45 p.m. | E. 46·5 | 47·0 | 48·3 12 faths. | Surface-net. — *Parathemisto*, sp. f.; *Dias longiremis*, f.; *Caligus rapax*, r.; *Sagitta*, sp. f.; small Ctenophora, f.; small (young) Crustacea, f. | Plaice, | 2 | 15 | 6 | 13 | 8 | 12 | *Asterias*, sp. fr.; *Solaster papposa*, f.; *Solaster endeca*, r.; *Ophiothrix rosula*, c.; *Actinoloba dianthus*, r.; some weed. | At beginning — Wind N.N.W., force 4; weather, clear; sea, moderate; tide, 5¼ hours ebb; barometer, 29·83; transparency, 3 fathoms. At finish—Wind N., force 3; tide, ¾ hour flood; barometer, 29·83; transparency, 3½ fathoms. |
| | | | | | Lemon soles, | 1 | 13 | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 4 | 10 | 24 | 9 | 22 | 6 | | |
| | | | | | " " | 44 | 5 | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 1 | 11 | 2 | 9 | 30 | 7 | | |
| | | | | | " " | 11 | 5½ | ... | ... | ... | ... | | |
| | W. 46·5 | 47·8 | 47·6 12 faths. | Bottom-net.—*Dexamine spinosa*, r.; *Calanus finmarchicus*, c.; *Caligus rapax*, f.; *Sagitta*, sp. ab. | Haddocks, | 1 | 10 | 4 | 7 | 12 | 6 | | |
| | | | | | Cod, | 1 | 18 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 1 | 10 | 9 | 8–9 | 12 | 5½ | | |
| | | | | | " | 2 | 3½ | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, | 1 | 18 | 6 | 6 | 1 | 3½ | | |
| | | | | | Anglers, | 1 | 22 | 1 | 14 | ... | ... | | |
| | | | | | Dragonet, | 1 | 7½ | ... | ... | ... | ... | | |
| Station III. 20th Nov. 1.15 p.m. to 3.40 p.m. | E. 46·8 | 47·5 | 47·4 13 fath. | Surface-net.—*Stenothöe*, sp. r.; *Parathemisto*, sp. r.; *Dias longiremis*, r.; *Oithona*, sp. r.; *Caligus rapax*, r.; *Sagitta*, sp. r.; young Crustacea, f.; small Ctenophora, r. | Thornback ray, | 1 | 22 | 1 | 18 | 5 | 12 | *Loligo vulgaris*, r.; *Pecten opercularis*, f.; *Nephrops norvegicus*, fr.; *Asterias*, sp. f.; *Solaster papposa*, fr.; *Actinoloba dianthus*, r. | At beginning — Wind W.N.W., force 6; weather, overcast; sea, moderate; tide, 2½ hours flood; barometer, 29·70; transparency, 2¼ fathoms. At finish—Wind W. by N., force 6; weather, dull; sea, slight; tide, 4¾ hours flood; barometer, 29·71; transparency, 2¾ fathoms. |
| | | | | | " | 3 | 9 | ... | ... | ... | ... | | |
| | | | | | Lemon soles, | 2 | 14 | 3 | 13 | 4 | 11 | | |
| | | | | | " " | 5 | 10 | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 5 | 9 | 29 | 7½ | 29 | 6½ | | |
| | | | | | " " | 5 | 5 | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 2 | 10 | 6 | 8½ | 29 | 6½ | | |
| | W. 47·7 | 48·0 | 48·3 14 fath. | Bottom-net. — *Thysanöessa*, sp. several; *Erythrops goesii*, several; *Mysis*, sp. f.; *Diastylis*, sp. f.; *Calanus finmarchicus*, fr.; *Parathemisto*, sp. fr.; *Atylus bispinosus*, f.; *Sagitta*, sp. c.; small Ctenophora, c.; young Crustacea, f.; young fish, f. | " " | 16 | 5 | ... | ... | ... | ... | | |
| | | | | | Haddocks, | 1 | 14 | 10 | 12 | 6 | 10 | | |
| | | | | | " | 14 | 6½ | ... | ... | ... | ... | | |
| | | | | | Cod, | 1 | 37 | 1 | 30 | 1 | 26 | | |
| | | | | | " | 3 | 16–22 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 19 | 13–14 | 35 | 11 | 79 | 8–9½ | | |
| | | | | | " | 2 | 6 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, | 3 | 5½ | ... | ... | ... | ... | | |
| | | | | | Hake, | 1 | 11 | ... | ... | ... | ... | | |
| | | | | | Anglers, | 3 | 18 | 1 | 16 | 1 | 12 | | |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1891.—I. FIRTH OF FORTH—*continued.*

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Water. Surface. | Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION IV. 20th Nov. 10.0 a.m. to 12 noon. | W. 46·8 | 45·4 | 45·4 5 faths. | Surface-net. — Net damaged. Bottom-net.—*Hippolyte*, sp. v.r.; *Mysis ornatus*, v.r.; *Calanus finmarchicus*, r.; *Caligus rapax*, f.; *Sagitta*, sp. f.; young Crustacea, f.; Infusoria, abundant (comprising five species of *Ceratium*, &c.). | Plaice, | 5 | 17–19 | 109 | 13–15 | 49 | 11 | *Pecten opercularis*, ab.; *Ostrea edulis*, v.r.; *Echinus esculentus*, f. | At beginning — Wind W., force 5; weather, overcast; sea, moderate; tide, 5¼ hours ebb; barometer, 29·71; transparency, 1⅜ fathoms. At finish—Wind W., force 6; tide, 1¼ hours flood; barometer, 29·72; transparency, 1⅜ fathoms. |
| | | | | | " | 35 | 9 | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 1 | 14 | 5 | 10–12 | 2 | 9 | | |
| | | | | | " " | 60 | 5½–7 | ... | .. | ... | ... | | |
| | | | | | Long rough dabs, | 1 | 9 | 2 | 7 | ... | ... | | |
| | E. 48·8 | 46·0 | 45·9 4 faths. | | Brill, | 1 | 12 | ... | ... | ... | ... | | |
| | | | | | Cod, | 1 | 29 | 1 | 18 | 1 | 12 | | |
| | | | | | " | 1 | 10 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 1 | 12 | 7 | 10–11 | 3 | 8 | | |
| | | | | | " | 2 | 5 | ... | ... | ... | ... | | |
| | | | | | Com. gurnard, | 1 | 13 | ... | ... | ... | ... | | |
| | | | | | Sprats, | 6 | 5 | 3 | 4 | ... | ... | | |
| STATION V. 24th Nov. 11.0 a.m to 1.0 p.m | W. 46·0 | 47·0 | 48·5 28 faths. | Surface-net.—*Parathemisto*, sp. f.; *Calanus finmarchicus*, r.; *Centropages*, sp. r.; *Sagitta*, sp. f.; Infusoria, c.; 1 young *Motella mustela*. Bottom-net.—*Thysanöessa*, sp. f.; *Mysis spiritus*, several; *Calisoma*, sp. fr.; *Atylus bispinosus*, c.; *Parathemisto*, sp. c.; *Tauria medusarum*, f.; *Calanus finmarchicus*, c.; *Sagitta*, sp. ab.; *Tomopteris*, fr.; Ctenophora, f.; young Crustacea, fr.; young fish (Herring?), r. | Plaice, | 1 | 16 | 3 | 15 | 1 | 14 | *Loligo vulgaris*, r.; *Nephrops norvegicus*, fr.; some weed (very little in net). | At beginning—Wind variable, light; weather, very hazy sea, easterly swell; tide, 1½ hours ebb; barometer, 29·81; transparency, 4¼ fathoms. At finish — Wind W.N.W., force 3; weather and sea as before; tide, 3¾ hours ebb; barometer, 29·80; transparency, 5¼ fathoms. |
| | | | | | " | 1 | 11 | ... | ... | ... | .. | | |
| | | | | | Common dabs, | 2 | 10 | 10 | 7–9 | 13 | 16 | | |
| | | | | | " " | 6 | 4½ | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 1 | 10 | 2 | 9 | 14 | 7–8 | | |
| | E. 45·8 | 47·2 | 48·5 21 faths. | | " " | 50 | 4½–6 | ... | ... | ... | ... | | |
| | | | | | Haddock, | 1 | 19 | ... | ... | ... | ... | | |
| | | | | | Cod, | 1 | 17 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 1 | 18 | 2 | 11 | 1 | 9 | | |
| | | | | | Hake, | 1 | 11 | ... | ... | ... | ... | | |
| | | | | | Anglers, | 1 | 30 | 1 | 20 | ... | ... | | |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1891.—I. FIRTH OF FORTH—*continued.*

| Station, Date, and Time Trawl down. | Temperature. | | | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. | | | | | | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Air. | Water. | | | | | | | | | | | |
| | Dry Bulb. | Surface. | Bottom. | | | No. | Inches | No. | Inches | No. | Inches | | |
| STATION VI. 25th Nov. 1.45 p.m. to 2.40 p.m. | W. 42·0 | 46·8 | 48·5 13 fath. | Surface-net. — *Atylus bispinosus*, f.; *Calanus finmarchicus*, f.; *Sagitta*, sp. f.; *Tomopteris*, sp. f.; Ctenophora, f. Bottom-net.—*Hippolyte pusilla*, r.; *Parathemisto*, sp. f.; *Calanus finmarchicus*, fr.; *Sagitta*, sp. fr.; (comparatively little in either net). | Plaice, . . | 10 | 20 | 44 | 14 | 12 | 10 | *Solaster endeca*, f.; *Echinus esculentus*, r. | At beginning—Wind S.S.W., force 5; weather, very hazy; sea, moderate; tide, 3½ hours ebb; barometer, 29·53; transparency, 4½ fathoms. At finish — Wind S.S.W., force 6; sea, rough; tide, 4½ hours ebb; barometer, 29·54; transparency, 4 fathoms. |
| | | | | | " . . | 2 | 8 | 20 | 17 | ... | ... | | |
| | | | | | Lemon soles, . | 2 | 15 | 1 | 14 | 2 | 13 | | |
| | | | | | " " | 3 | 11 | ... | ... | ... | ... | | |
| | | | | | Common dabs, . | 1 | 11 | 33 | 8–9 | 14 | 6 | | |
| | E. 42·5 | 47·0 | 48·2 15 fath. | | " " . | 2 | 4 | ... | ... | .. | ... | | |
| | | | | | Brill, . . . | 1 | 22 | 1 | 21 | 1 | 14 | | |
| | | | | | Cod, . . . | 1 | 22 | 1 | 19 | ... | ... | | |
| | | | | | Whiting, . . | 1 | 12 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, . | 1 | 14 | 1 | 13 | 1 | 5½ | | |
| | | | | | Dragonet, . . | 1 | 9 | 1 | 8 | ... | ... | | |
| STATION VII. 24th Nov. 2.5 p.m. to 3.50 p.m. | E. 39·5 | 45·0 | 47·6 17 fath. | Surface-net—*Idotea marina*, f.; *Mysis flexuosus*, r.; *Parathemisto*, sp. f.; Infusoria, fr.; some fragments of weed. Bottom-net.—*Calisoma*, sp. r.; *Atylus bispinosus*, r.; *Parathemisto*, sp. c.; *Calanus finmarchicus*, f.; *Sagitta*, sp. ab.; *Tomopteris*, fr.; Ctenophora, fr. | Plaice, . . | 2 | 18 | 1 | 17 | 1 | 16 | *Octopus*, sp., 1; *Asterias*, sp. fr.; *Luidia sarsii*, several; *Solaster endeca*, f.; *Echinus esculentus*, fr.; *Alcyonium*, sp. fr. | At beginning — Wind W., force 2; weather, very hazy; sea, easterly swell; tide, 5 hours ebb; barometer, 29·78; transparency, 3½ fathoms. At finish—Wind W., force 1; weather, as before; sea, slight; tide, ¾ hours flood; barometer, 29·78; transparency, 3 fathoms. |
| | | | | | " . . | 1 | 14 | ... | ... | ... | ... | | |
| | | | | | Lemon soles, . | 1 | 15 | 1 | 14 | 1 | 10 | | |
| | | | | | Common dabs, . | 1 | 7 | 3 | 6 | 3 | 5 | | |
| | | | | | Long rough dabs, | 1 | 9 | 1 | 8 | 5 | 7 | | |
| | W. 39·0 | 45·0 | 47·7 10 fath. | | " " | 3 | 6 | ... | ... | ... | ... | | |
| | | | | | Haddocks, . . | 1 | 22 | 1 | 19 | 1 | 15 | | |
| | | | | | " . . | 3 | 13 | 5 | 11 | 1 | 9 | | |
| | | | | | " . . | 17 | 6 | ... | ... | ... | ... | | |
| | | | | | Whitings, . . | 3 | 12 | 1 | 11 | 9 | 9 | | |
| | | | | | " . . | 4 | 8 | ... | ... | ... | ... | | |
| | | | | | Angler, . . | 1 | 18 | ... | ... | ... | ... | | |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1891.—I. FIRTH OF FORTH—*continued.*

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Water. Surface. | Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION I. 17th Dec. 1.5 p.m. to 3.15 p.m. —*continued.* | W. 40·0 | 6·8 | 7·0 12 fath. | | Lemon soles . | 6 | 8 | 4 | 6 | ... | ... | | tide, about 3¼ hours flood; barometer, 30·33; transparency, 3 fathoms. At finish—Wind W.; weather, hazy; sea, strong S.E. swell; tide, 5½ hours flood; barometer, 30·32; transparency, 2 fathoms. |
| | | | | | Common dabs, . | 1 | 11 | 2 | 10 | 2 | 9 | | |
| | | | | | " " . | 19 | 8 | 12 | 5 | ... | ... | | |
| | | | | | Long rough dabs, | 2 | 10 | 5 | 9 | 24 | 7 | | |
| | | | | | " " | 14 | 6 | ... | ... | ... | ... | | |
| | | | | | Haddocks, . . | 4 | 14 | 7 | 13 | 4 | 12 | | |
| | | | | | Cod, . . . | 1 | 27 | 2 | 24 | 1 | 19 | | |
| | | | | | " . . . | 1 | 18 | 1 | 17 | ... | ... | | |
| | | | | | Whitings, . . | 1 | 14 | 2 | 13 | 12 | 12 | | |
| | | | | | " . . | 20 | 9 | 7 | 5 | ... | ... | | |
| | | | | | Brassie, . . | 1 | 7 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, . | 1 | 5 | ... | ... | ... | ... | | |
| | | | | | Anglers, . . | 1 | 21 | 1 | 14 | ... | ... | | |
| | | | | | Pogge, . . | 1 | 5 | ... | ... | ... | .. | | |
| | | | | | Cat-fish, . . | 1 | 36 | 1 | 34 | 1 | 28 | | |
| STATION II. 17th Dec. 10.45 a.m. to 12.30 p.m. | E. 40·0 | 6·1 | 7·4 12 fath. | | Starry ray, . | 1 | 10 | ... | ... | ... | ... | | At beginning—Wind S., force 1; weather, hazy; sea, strong S.E. swell; tide, nearly ¼ hour flood; barometer, 30·33 transparency, 2¼ fathoms. At finish — Wind N.W., force 1; weather, fog; sea, strong S.E. swell; tide, nearly ½ hour flood; barometer, 30·33; transparency, 3 fathoms. |
| | | | | | Thornback ray, . | 1 | 18 | ... | ... | ... | ... | | |
| | | | | | Plaice, . . | 1 | 15 | 7 | 14 | 6 | 12 | | |
| | | | | | " . . | 2 | 10 | ... | ... | ... | ... | | |
| | | | | | Common dabs, . | 1 | 10 | 2 | 8 | 5 | 7 | | |
| | W. 39·0 | 5·8 | 7·0 12 fath. | | " " . | 5 | 6 | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 1 | 12 | 1 | 11 | 7 | 9 | | |
| | | | | | " " | 12 | 6 | ... | ... | ... | ... | | |
| | | | | | Haddocks, . . | 4 | 12 | 21 | 11 | 8 | 10 | | |
| | | | | | " . . | 26 | 6 | ... | ... | ... | ... | | |
| | | | | | Cod, . . . | 1 | 15 | ... | ... | ... | ... | | |
| | | | | | Whitings, . . | 16 | 10 | 11 | 8 | 6 | 7 | | |
| | | | | | " . . | 6 | 5 | 1 | 4 | ... | ... | | |
| | | | | | Angler, . . | 1 | 55 | ... | ... | ... | ... | | |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1891.—I. FIRTH OF FORTH—*continued*.

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Temperature. Water. Surface. | Temperature. Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION VIII. 23rd Nov. 10.50 a.m. to 12.45 p.m. | S.W. 48·0<br>N.E. 48·0 | 46·1<br>48·4 | 48·8 20 fath.<br>48·8 26 fath. | Surface-net.—*Parathemisto*, sp. r.; *Calanus finmarchicus*, r.; *Dias*, sp. r.; *Sagitta*, sp. r.; Infusoria, fr.<br>Bottom-net.—*Thysanoëssa*, sp. f.; *Mysis*, sp. r.; *Calisoma crenata*, f.; *Atylus bispinosus*, fr.; *Parathemisto*, sp. c.; *Calanus finmarchicus*, ab.; *Caligus rapax*, f.; *Sagitta*, sp. c.; *Tomopteris*, sp. r.; young Crustacea, fr. | Starry ray, | 1 | 10 | ... | ... | ... | ... | *Loligo*, sp., 2 (one 38 inches long, including tentacles; the other small); *Asterias*, sp. r.; *Solaster papposus*, r. | At beginning—Wind S.S.E., force 1; weather, a little hazy; sea, S.E. swell; tide, ½ hour ebb; barometer, 29·81; transparency, 4 fathoms.<br>At finish — Sea easterly swell; tide, 4½ hours ebb; barometer, 29·81; transparency, 6½ fathoms. |
| | | | | | Plaice, | 1 | 18 | 1 | 16 | ... | ... | | |
| | | | | | Common dabs, | 3 | 8 | 1 | 5 | ... | ... | | |
| | | | | | Long rough dabs, | 2 | 7 | 3 | 5 | ... | .. | | |
| | | | | | Haddocks, | 1 | 14 | 2 | 18 | 1 | 12 | | |
| | | | | | Whitings, | 1 | 16 | 3 | 10–11 | 1 | 9 | | |
| | | | | | " | 2 | 6 | ... | ... | ... | ... | | |
| STATION IX. 23rd Nov. 1.40 p.m. to 3.30 p.m. | S.E. 49·0<br>N.W. 49·5 | 47·8<br>48·2 | 49·0 32 fath.<br>49·0 27 fath. | Surface-net.—*Calanus finmarchicus*, r.; *Sagitta*, sp. r.; Ctenophora, r.; 3 young *Motella mustela*.<br>Bottom-net. — *Calisoma crenata*, fr.; *Atylus bispinosus*, fr.; *Parathemisto*, sp. fr.; *Calanus finmarchicus*, c.; *Caligus rapax*, f.; *Sagitta*, sp. c.; *Tomopteris*, sp. fr.; young fish, v.r. | Grey skate, | 1 | 15 | ... | ... | ... | ... | *Loligo*, sp. (juv.), f.; *Nephrops norvegicus*, fr. | At beginning—Wind W.S.W., force 2; weather, moderately clear; sea, easterly swell; tide, low water; barometer, 29·81; transparency, 6½ fathoms.<br>At finish — Wind S.W., force 3; tide, 1½ hours flood; barometer, 29·81; transparency, 7 fathoms. |
| | | | | | Thornback ray, | 1 | 21 | ... | ... | ... | ... | | |
| | | | | | Plaice, | 1 | 18 | 1 | 16 | ... | ... | | |
| | | | | | Lemon soles, | 1 | 12 | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 2 | 9 | 2 | 7 | 8 | 6 | | |
| | | | | | " " | 9 | 5 | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 2 | 8 | 22 | 7 | 28 | 5-6 | | |
| | | | | | " " | 1 | 8 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, | 2 | 5½ | ... | ... | ... | ... | | |
| | | | | | Angler, | 1 | 29 | ... | ... | ... | ... | | |
| STATION I. 17th Dec. 1.5 p.m. to 3.15 p.m. | E. 38·0 | 7·4 | 7·5 16 fath. | | Thornback ray, | 1 | 20 | 1 | 14 | 1 | 12 | | At beginning — Wind S.W., force 2; weather, fog; sea, strong S.E. swell; |
| | | | | | " " | 1 | 9 | ... | ... | ... | ... | | |
| | | | | | Plaice, | 3 | 15 | 7 | 14 | 4 | 12 | | |
| | | | | | Lemon soles, | 2 | 18 | 14 | 12 | 6 | 10 | | |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1891.—I. FIRTH OF FORTH—*continued*.

| Station, Date, and Time Trawl down. | Temperature. | | | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. | | | | | | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Air. | Water. | | | | | | | | | | | |
| | Dry Bulb. | Surface. | Bottom. | | | No. | Inches | No. | Inches | No. | Inches | | |
| STATION I. 17th Dec. 1.5 p.m. to 3.15 p.m. —*continued*. | W. 40·0 | 6·8 | 7·0 12 fath. | | Lemon soles | 6 | 8 | 4 | 6 | ... | ... | | tide, about 3¼ hours flood; barometer, 30·33; transparency, 3 fathoms. At finish—Wind W.; weather, hazy; sea, strong S.E. swell; tide, 5½ hours flood; barometer, 30·32; transparency, 2 fathoms. |
| | | | | | Common dabs, | 1 | 11 | 2 | 10 | 2 | 9 | | |
| | | | | | " " | 19 | 8 | 12 | 5 | ... | ... | | |
| | | | | | Long rough dabs, | 2 | 10 | 5 | 9 | 24 | 7 | | |
| | | | | | " " | 14 | 6 | ... | ... | ... | ... | | |
| | | | | | Haddocks, | 4 | 14 | 7 | 13 | 4 | 12 | | |
| | | | | | Cod, | 1 | 27 | 2 | 24 | 1 | 19 | | |
| | | | | | " | 1 | 18 | 1 | 17 | ... | ... | | |
| | | | | | Whitings, | 1 | 14 | 2 | 13 | 12 | 12 | | |
| | | | | | " | 20 | 9 | 7 | 5 | ... | ... | | |
| | | | | | Brassie, | 1 | 7 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, | 1 | 5 | ... | ... | ... | ... | | |
| | | | | | Anglers, | 1 | 21 | 1 | 14 | ... | ... | | |
| | | | | | Pogge, | 1 | 5 | ... | ... | ... | ... | | |
| | | | | | Cat-fish, | 1 | 36 | 1 | 34 | 1 | 28 | | |
| STATION II. 17th Dec. 10.45 a.m. to 12.30 p.m. | E. 40·0 | 6·1 | 7·4 12 fath. | | Starry ray, | 1 | 10 | ... | ... | ... | ... | | At beginning—Wind S., force 1; weather, hazy; sea, strong S.E. swell; tide, nearly ¼ hour flood; barometer, 30·33 transparency, 2¼ fathoms. At finish — Wind N.W., force 1; weather, fog; sea, strong S.E. swell; tide, nearly ½ hour flood; barometer, 30·33; transparency, 3 fathoms. |
| | | | | | Thornback ray, | 1 | 18 | ... | ... | ... | ... | | |
| | | | | | Plaice, | 1 | 15 | 7 | 14 | 6 | 12 | | |
| | | | | | " | 2 | 10 | ... | ... | ... | ... | | |
| | W. 39·0 | 5·8 | 7·0 12 fath. | | Common dabs, | 1 | 10 | 2 | 8 | 5 | 7 | | |
| | | | | | " " | 5 | 6 | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 1 | 12 | 1 | 11 | 7 | 9 | | |
| | | | | | " " | 12 | 6 | ... | ... | ... | ... | | |
| | | | | | Haddocks, | 4 | 12 | 21 | 11 | 8 | 10 | | |
| | | | | | " | 26 | 6 | ... | ... | ... | ... | | |
| | | | | | Cod, | 1 | 15 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 16 | 10 | 11 | 8 | 6 | 7 | | |
| | | | | | " | 6 | 5 | 1 | 4 | ... | ... | | |
| | | | | | Angler, | 1 | 55 | ... | ... | ... | ... | | |

TABLE C.—Record of Observations made on Board the 'Garland' during 1891.—I. Firth of Forth—*continued*.

| Station, Date, and Time Trawl down. | Temperature. | | | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. | | | | | | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Air. | Water. | | | | | | | | | | | |
| | Dry Bulb. | Surface. | Bottom. | | | No. | Inches | No. | Inches | No. | Inches | | |
| Station III.<br>24th Dec.<br>10.20 a.m. to<br>12.10 p.m. | W. 39·0 | 6·1c | 7·1c<br>9<br>fath. | Surface-net. — *Parathemisto*, sp. c.; *Calanus finmarchicus*, f.<br>Bottom-net. — *Boreophausia*, sp. fr.; *Parathemisto*, sp. c.; *Hyperia*, sp. r.; *Calanus finmarchicus*, c.; *Sagitta*, sp. c.; *Caligus*, sp. r. | Thornback ray, . | 2 | 18 | 1 | 14 | ... | ... | *Pecten opercularis*, f.; *Loligo vulgaris*, r.; *Echinus esculentus*, f.; *Solaster papposa*, f.; *Solaster endeca*, f.; *Asterias*, sp. f.; *Ophiothrix rosula*, f.; *Actinoloba dianthus*, fr. | At beginning — Wind W., force 5; weather, light fog; sea, moderate; tide, 1¼ hours ebb; barometer, 30·14; transparency, 2¼ fathoms.<br>At finish—Wind, weather and sea as before; tide, 3 hours ebb; barometer, 30·13; transparency, 3 fathoms. |
| | | | | | Lemon soles, . | 1 | 15 | 1 | 14 | 3 | 11-12 | | |
| | | | | | " " . | 1 | 10 | ... | ... | ... | ... | | |
| | | | | | Common dabs, . | 1 | 10 | 1 | 9 | 7 | 8 | | |
| | | | | | " " . | 23 | 5-6 | ... | ... | ... | ... | | |
| | E. 39·0 | 6·5c | 7·0c<br>11<br>fath. | | Long rough dabs, | 3 | 9 | 2 | 8 | 9 | 7 | | |
| | | | | | " " . | 7 | 5 | ... | ... | ... | ... | | |
| | | | | | Haddocks, . . | 1 | 18 | 2 | 12 | 1 | 10 | | |
| | | | | | " . . . | 18 | 6 | ... | ... | ... | ... | | |
| | | | | | Cod, . . . | 1 | 41 | 3 | 16 | 1 | 15 | | |
| | | | | | " . . . | 1 | 11 | ... | ... | ... | ... | | |
| | | | | | Ling, . . . | 1 | 21 | ... | ... | ... | ... | | |
| | | | | | Whitings, . . | 3 | 13½ | 22 | 11½ | 16 | 9 | | |
| | | | | | " . . . | 4 | 8 | ... | ... | ... | ... | | |
| | | | | | Brassie, . . | 2 | 7 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, . | 1 | 8 | 1 | 4 | ... | ... | | |
| | | | | | Anglers, . . | 1 | 26 | 1 | 17 | ... | ... | | |
| Station IV.<br>18th Dec.<br>10.50 a.m.<br>to 2.10 p.m. | E. 41·0 | 6·5 | 6·6<br>8<br>fath. | | Plaice, . . | 2 | 16 | 3 | 15 | 13 | 14 | | At beginning — Wind S.W., force 2; weather, hazy; sea, slight E. swell; tide, nearly 1 hour flood; barometer, 30·36; transparency, 2 fathoms.<br>At finish—Wind S., force 2; weather, dull and hazy; sea, |
| | | | | | " . . . | 8 | 13 | 2 | 11 | ... | ... | | |
| | | | | | Lemon sole, . | 1 | 11 | 3 | 10 | 4 | 9 | | |
| | | | | | " " . | 4 | 8 | 3 | 6 | ... | ... | | |
| | | | | | Common dabs, . | 1 | 13 | 4 | 10 | 11 | 9 | | |
| | W. 43·0 | 6·3 | 6·5<br>6<br>fath. | | " " . | 41 | 8 | 49 | 7 | 25 | 5 | | |
| | | | | | " " . | 4 | 4 | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 4 | 10 | 11 | 9 | 22 | 8 | | |
| | | | | | " " . | 3 | 6 | 3 | 5 | ... | ... | | |
| | | | | | Haddock, . . | 1 | 6 | ... | ... | ... | ... | | |
| | | | | | Cod, . . . | 1 | 30 | 1 | 23 | 1 | 22 | | |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD 'THE GARLAND' DURING 1891.—I. FIRTH OF FORTH—*continued*.

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Temperature. Water. Surface. | Temperature. Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION IV. 18th Dec. 10.50 a.m. to 2.10 p.m. —*continued.* | | | | | Cod, | 2 | 20 | 4 | 16 | 2 | 13 | | smooth; tide, nearly ¾ flood; barometer, 30·34; transparency, 2¾ fathoms. |
| | | | | | ,, | 7 | 12 | 1 | 7 | ... | ... | | |
| | | | | | Whitings, | 2 | 13 | 37 | 12 | 37 | 9 | | |
| | | | | | ,, | 45 | 8 | 23 | 6 | 6 | 5 | | |
| | | | | | Anglers, | 1 | 18 | 2 | 16 | 3 | 13 | | |
| STATION V. 23rd Dec. 10.45 a.m to 1.10 p.m. | W. 42·5 | 7·4c | 7·6c 29 fath. | Surface-net.—*Tauria*, sp. r.; *Parathemisto*, sp. f.; *Calanus finmarchicus*, f.; *Sagitta*, sp. f. | Thornback ray, | 1 | 11 | ... | ... | .. | ... | *Octopus vulgaris*, 1; *Loligo vulgaris*, 2; *Nephrops norvegicus*, r.; *Asterias*, sp. r. | At beginning — Wind W., force 5; weather, hazy; sea, slight; tide, 2¾ hours ebb; barometer, 30·33; transparency, 5 fathoms. |
| | | | | | Plaice, | 3 | 16 | 1 | 14 | 1 | 13 | | |
| | | | | | Common dabs, | 1 | 10 | 1 | 8 | 3 | 7 | | |
| | | | | | ,, ,, | 3 | 6 | ... | ... | ... | ... | | |
| | E. 43·0 | 7·4c | 7·7c 23 fath. | Bottom-net.—*Parathemisto*, sp. ab.; *Atylus bispinosus*, fr.; *Calisoma crenata*, f.; *Calanus finmarchicus*, c.; *Sagitta*, sp. ab. | Long rough dabs, | 3 | 9 | 11 | 7½ | 11 | 5 | | |
| | | | | | Haddocks, | 3 | 6 | ... | ... | ... | ... | | |
| | | | | | Cod, | 1 | 22 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 2 | 17 | 1 | 15 | 1 | 11 | | At finish—Wind W.S.W., force 4; weather and sea as before; tide, 5¾ hours ebb; barometer, 30·33; transparency, 6 fathoms. |
| | | | | | ,, | 2 | 10 | ... | ... | ... | ... | | |
| | | | | | Hake, | 1 | 17 | ... | ... | ... | ... | | |
| | | | | | Anglers, | 1 | 25 | 1 | 19 | ... | ... | | |
| | | | | | Dragonet, | 1 | 6 | ... | ... | ... | ... | | |
| STATION VI. 33rd Dec. 2.30 p.m. to 3.20 p.m. | E. 41·0 | 7·1c | 7·2c 12½ fath. | Surface-net. — *Parathemisto*, sp. f.; *Sagitta*, sp. r.; small Ctenophores, f. | Plaice, | 3 | 18½ | 14 | 17 | 33 | 16 | *Octopus vulgaris*, 2; *Echinus esculentus*, several; *Asterias*, sp. fr.; *Ophioglypha albida*, fr. | At beginning — Wind N.W., force 2; weather, fog; sea, slight; tide, low water; barometer, 30·29; transparency, 4½ fathoms. |
| | | | | | ,, | 4 | 11 | ... | ... | ... | ... | | |
| | | | | | Lemon soles, | 2 | 14 | 1 | 13 | 4 | 12 | | |
| | | | | | Common dabs, | 3 | 10 | 5 | 8 | 5 | 7 | | |
| | | | | | ,, ,, | 17 | 5-6 | ... | ... | ... | ... | | |
| | W. 40·5 | 7·2c | 7·5c 18½ fath. | Bottom-net. — *Calanus finmarchicus*, fr.; *Sagitta*, sp. c. | Long rough dabs, | 1 | 8 | 2 | 7 | 1 | 6 | | |
| | | | | | Turbot, | 1 | 25 | ... | ... | ... | ... | | |
| | | | | | Brill, | 1 | 25 | 1 | 24 | 1 | 21 | | At finish—Wind |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1891.—I. FIRTH OF FORTH—*continued.*

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Temperature. Water. Surface. | Temperature. Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION III. 24th Dec. 10.20 a.m. to 12.10 p.m. | W. 39·0 | 6·1c | 7·1c 9 fath. | Surface-net. — *Parathemisto*, sp. c.; *Calanus finmarchicus*, f. Bottom-net. — *Boreophausia*, sp. fr.; *Parathemisto*, sp. c.; *Hyperia*, sp. r.; *Calanus finmarchicus*, c.; *Sagitta*, sp. c.; *Caligus*, sp. r. | Thornback ray, | 2 | 18 | 1 | 14 | ... | ... | *Pecten opercularis*, f.; *Loligo vulgaris*, r.; *Echinus esculentus*, f.; *Solaster papposa*, f.; *Solaster endeca*, f.; *Asterias*, sp. f.; *Ophiothrix rosula*, f.; *Actinoloba dianthus*, fr. | At beginning — Wind W., force 5; weather, light fog; sea, moderate; tide, 1½ hours ebb; barometer, 30·14; transparency, 2½ fathoms. At finish—Wind, weather and sea as before; tide, 3 hours ebb; barometer, 30·13; transparency, 3 fathoms. |
| | | | | | Lemon soles, | 1 | 15 | 1 | 14 | 3 | 11-12 | | |
| | | | | | ” ” | 1 | 10 | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 1 | 10 | 1 | 9 | 7 | 8 | | |
| | | | | | ” ” | 23 | 5–6 | ... | ... | ... | ... | | |
| | E. 39·0 | 6·5c | 7·0c 11 fath. | | Long rough dabs, | 3 | 9 | 2 | 8 | 9 | 7 | | |
| | | | | | ” ” | 7 | 5 | ... | ... | ... | ... | | |
| | | | | | Haddocks, | 1 | 18 | 2 | 12 | 1 | 10 | | |
| | | | | | ” | 18 | 6 | ... | ... | ... | ... | | |
| | | | | | Cod, | 1 | 41 | 3 | 16 | 1 | 15 | | |
| | | | | | ” | 1 | 11 | ... | ... | ... | ... | | |
| | | | | | Ling, | 1 | 21 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 3 | 13½ | 22 | 11½ | 16 | 9 | | |
| | | | | | ” | 4 | 8 | ... | ... | ... | ... | | |
| | | | | | Brassie, | 2 | 7 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, | 1 | 8 | 1 | 4 | ... | ... | | |
| | | | | | Anglers, | 1 | 26 | 1 | 17 | ... | ... | | |
| STATION IV. 18th Dec. 10.50 a.m. to 2.10 p.m. | E. 41·0 | 6·5 | 6·6 8 fath. | | Plaice, | 2 | 16 | 3 | 15 | 13 | 14 | | At beginning — Wind S.W., force 2; weather, hazy; sea, slight E. swell; tide, nearly 1 hour flood; barometer, 30·36; transparency, 2 fathoms. At finish—Wind S., force 2; weather, dull and hazy; sea, |
| | | | | | ” | 8 | 13 | 2 | 11 | ... | ... | | |
| | | | | | Lemon sole, | 1 | 11 | 3 | 10 | 4 | 9 | | |
| | | | | | ” ” | 4 | 8 | 3 | 6 | ... | ... | | |
| | | | | | Common dabs, | 1 | 13 | 4 | 10 | 11 | 9 | | |
| | W. 43·0 | 6·3 | 6·5 6 fath. | | ” ” | 41 | 8 | 49 | 7 | 25 | 5 | | |
| | | | | | ” ” | 4 | 4 | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 4 | 10 | 11 | 9 | 22 | 8 | | |
| | | | | | ” ” | 8 | 6 | 3 | 5 | ... | ... | | |
| | | | | | Haddock, | 1 | 6 | ... | ... | ... | ... | | |
| | | | | | Cod, | 1 | 30 | 1 | 23 | 1 | 22 | | |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD 'THE GARLAND' DURING 1891.—I. FIRTH OF FORTH—*continued.*

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Water. Surface. | Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION IV. 18th Dec. 10.50 a.m. to 2.10 p.m. —*continued.* | | | | | Cod, | 2 | 20 | 4 | 16 | 2 | 13 | | smooth; tide, nearly ¾ flood; barometer, 30·34; transparency, 2¾ fathoms. |
| | | | | | " | 7 | 12 | 1 | 7 | ... | ... | | |
| | | | | | Whitings, | 2 | 13 | 37 | 12 | 37 | 9 | | |
| | | | | | " | 45 | 8 | 23 | 6 | 6 | 5 | | |
| | | | | | Anglers, | 1 | 18 | 2 | 16 | 3 | 13 | | |
| STATION V. 23rd Dec. 10.45 a.m to 1.10 p.m. | W. 42·5 | 7·4c | 7·6c 29 fath. | Surface-net.—*Tauria*, sp. r.; *Parathemisto*, sp. f.; *Calanus finmarchicus*, f.; *Sagitta*, sp. f. | Thornback ray, | 1 | 11 | ... | ... | ... | ... | *Octopus vulgaris*, 1; *Loligo vulgaris*, 2; *Nephrops norvegicus*, r.; *Asterias*, sp. r. | At beginning — Wind W., force 5; weather, hazy; sea, slight; tide, 2¼ hours ebb; barometer, 30·33; transparency, 5 fathoms. |
| | | | | | Plaice, | 3 | 16 | 1 | 14 | 1 | 13 | | |
| | | | | | Common dabs, | 1 | 10 | 1 | 8 | 3 | 7 | | |
| | | | | | " | 3 | 6 | ... | ... | ... | ... | | |
| | E. 43·0 | 7·4c | 7·7c 23 fath. | Bottom-net. — *Parathemisto*, sp. ab.; *Atylus bispinosus*, fr.; *Calisoma crenata*, f.; *Calanus finmarchicus*, c.; *Sagitta*, sp. ab. | Long rough dabs, | 3 | 9 | 11 | 7½ | 11 | 5 | | |
| | | | | | Haddocks, | 3 | 6 | ... | ... | ... | ... | | |
| | | | | | Cod, | 1 | 22 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 2 | 17 | 1 | 15 | 1 | 11 | | At finish—Wind W.S.W., force 4; weather and sea as before; tide, 5¾ hours ebb; barometer, 30·33; transparency, 6 fathoms. |
| | | | | | " | 2 | 10 | ... | ... | ... | ... | | |
| | | | | | Hake, | 1 | 17 | ... | ... | ... | ... | | |
| | | | | | Anglers, | 1 | 25 | 1 | 19 | ... | ... | | |
| | | | | | Dragonet, | 1 | 6 | ... | ... | ... | ... | | |
| STATION VI. 33rd Dec. 2.30 p.m. to 3.20 p.m. | E. 41·0 | 7·1c | 7·2c 12½ fath. | Surface-net. — *Parathemisto*, sp. f.; *Sagitta*, sp. r.; small Ctenophores, f. | Plaice, | 3 | 18½ | 14 | 17 | 33 | 16 | *Octopus vulgaris*, 2; *Echinus esculentus*, several; *Asterias*, sp. fr.; *Ophioglypha albida*, fr. | At beginning — Wind N.W., force 2; weather, fog; sea, slight; tide, low water; barometer, 30·29; transparency, 4½ fathoms. |
| | | | | | " | 4 | 11 | ... | ... | ... | ... | | |
| | | | | | Lemon soles, | 2 | 14 | 1 | 13 | 4 | 12 | | |
| | | | | | Common dabs, | 3 | 10 | 5 | 8 | 5 | 7 | | |
| | | | | | " " | 17 | 5–6 | ... | ... | ... | ... | | |
| | W. 40·5 | 7·2c | 7·5c 18½ fath. | Bottom-net. — *Calanus finmarchicus*, fr.; *Sagitta*, sp. c. | Long rough dabs, | 1 | 8 | 2 | 7 | 1 | 6 | | |
| | | | | | Turbot, | 1 | 25 | ... | ... | ... | ... | | |
| | | | | | Brill, | 1 | 25 | 1 | 24 | 1 | 21 | | At finish—Wind |

TABLE C.—Record of Observations made on Board the 'Garland' during 1891.—I. Firth of Forth—*continued*.

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Temperature. Water. Surface. | Temperature. Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station IX. 30th Oct. 1.30 p.m to 3.30 p.m. | N.W. 49·0 | 50·9 | 51·3 28 fath. | Surface-net. — *Hyperia*, sp. f.; *Sagitta*, sp. f.; small Ctenophora, ab.; young fish (*Motella*), 1. | Thornback ray, | 1 | 24 | 1 | 12 | ... | ... | *Loligo*, sp. several (juv.); *Tritonia hombergi*, 1; *Nephrops norvegicus*, fr.; *Cancer pagurus*, f. | At beginning—Wind E.N.E., force 2; weather, very hazy; sea, smooth; tide, ½ hour ebb; barometer, 30·55; transparency, 9 fathoms. At finish — Wind variable, light; weather and sea as before; tide, 2½ hours ebb; barometer, 30·56; transparency, 9¼ fathoms. |
| | | | | | Plaice, | 1 | 18 | 1 | 17 | 1 | 15 | | |
| | | | | | " | 9 | 12-13 | ... | ... | ... | ... | | |
| | | | | | Lemon soles, | 1 | 14 | ... | ... | ... | ... | | |
| | S.E. 49·0 | 51·0 | 51·0 31 fath. | Bottom-net. — *Calisoma*, sp. fr.; *Atylus*, sp. f.; *Calanus finmarchicus*, fr.; *Temora longicornis*, f.; *Sagitta*, sp. ab.; *Tomopteris*, sp. fr.; small Ctenophora, f. | Common dabs, | 1 | 10 | 12 | 8 | 53 | 6½ | | |
| | | | | | " " | 40 | 4-5½ | ... | ... | ... | ... | | |
| | | | | | Witch soles, | 1 | 18 | 3 | 13 | 1 | 11 | | |
| | | | | | Long rough dabs, | 2 | 10 | 5 | 8½ | 33 | 7 | | |
| | | | | | " " | 38 | 5-6 | ... | ... | ... | ... | | |
| | | | | | Haddocks, | 4 | 6 | ... | ... | ... | ... | | |
| | | | | | Cod, | 1 | 14 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, | 1 | 14 | 3 | 12 | 1 | 10 | | |
| | | | | | " " | 3 | 7-9 | ... | ... | ... | ... | | |
| Station I. 25th Nov. 10.23 a.m. to 12.28 p.m. | W. 41·5 | 45·8 | 48·0 11½ fath. | Surface-net. — *Parathemisto*, sp. fr.; Ctenophora, f.; *Tomopteris*, sp. r.; young Crustacea, fr.; Infusoria, fr. | Thornback ray, | 2 | 13 | ... | ... | ... | ... | *Pecten opercularis*, fr.; *Nephrops norvegicus*, r.; *Asterias*, sp. f.; *Solaster endeca*, f.; *Solaster papposa*, r.; *Echinus esculentus*, f. | At beginning — Wind S., force 4; weather, very hazy; sea, moderate; tide, high water; barometer, 29·55; transparency, 2 fathoms. At finish—Wind S.S.W., force 5; tide, 2 hours ebb; barometer, 29·55; transparency, 4½ fathoms. |
| | | | | | Plaice, | 1 | 14 | 2 | 12 | 3 | 11 | | |
| | | | | | Lemon soles, | 3 | 12 | 6 | 10½ | 8 | 9 | | |
| | | | | | " " | 2 | 7 | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 1 | 10 | 16 | 8½ | 9 | 6 | | |
| | E. 42·0 | 47·0 | 48·1 17½ fath. | Bottom-net. — *Parathemisto*, sp. f.; *Calanus finmarchicus*, ab.; *Sagitta*, sp. ab.; *Tomopteris*, sp. f.; Ctenophora, f.; young fish, r. | " " | 11 | 5 | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 1 | 9 | 1 | 8 | 2 | 7 | | |
| | | | | | " " | 3 | 5 | ... | ... | ... | ... | | |
| | | | | | Cod, | 1 | 28 | 2 | 20 | 6 | 19 | | |
| | | | | | " | 3 | 15 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 3 | 15 | 6 | 12½ | 7 | 9 | | |
| | | | | | " | 15 | 4½-6 | ... | ... | ... | ... | | |
| | | | | | Anglers, | 1 | 26 | 1 | 22 | 1 | 16 | | |

TABLE C.—Record of Observations made on Board the 'Garland' during 1891.—I. Firth of Forth—*continued.*

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Temperature. Water. Surface. | Temperature. Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station II. 21st Nov. 11.15 a.m to 12.45 p.m. | E. 46·5 | 47·0 | 48·3 12 faths. | Surface-net. — *Parathemisto*, sp. f.; *Dias longiremis*, f.; *Caligus rapax*, r.; *Sagitta*, sp. f.; small Ctenophora, f.; small (young) Crustacea, f. | Plaice, | 2 | 15 | 6 | 13 | 8 | 12 | *Asterias*, sp. fr.; *Solaster papposa*, f.; *Solaster endeca*, r.; *Ophiothrix rosula*, c.; *Actinoloba dianthus*, r.; some weed. | At beginning — Wind N.N.W., force 4; weather, clear; sea, moderate; tide, 5¼ hours ebb; barometer, 29·83; transparency, 3 fathoms. At finish—Wind N., force 3; tide, ¾ hour flood; barometer, 29·83; transparency, 3½ fathoms. |
| | | | | | Lemon soles, | 1 | 18 | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 4 | 10 | 24 | 9 | 22 | 6 | | |
| | | | | | ,, | 44 | 5 | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 1 | 11 | 2 | 9 | 30 | 7 | | |
| | | | | | ,, ,, | 11 | 5½ | ... | ... | ... | ... | | |
| | W. 46·5 | 47·8 | 47·6 12 faths. | Bottom-net.—*Dexamine spinosa*, r.; *Calanus finmarchicus*, c.; *Caligus rapax*, f.; *Sagitta*, sp. ab. | Haddocks, | 1 | 10 | 4 | 7 | 12 | 6 | | |
| | | | | | Cod, | 1 | 18 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 1 | 10 | 9 | 8–9 | 12 | 5½ | | |
| | | | | | ,, | 2 | 3½ | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, | 1 | 18 | 6 | 6 | 1 | 3½ | | |
| | | | | | Anglers, | 1 | 22 | 1 | 14 | ... | ... | | |
| | | | | | Dragonet, | 1 | 7½ | ... | ... | ... | ... | | |
| Station III. 20th Nov. 1.15 p.m. to 3.40 p.m. | E. 46·8 | 47·5 | 47·4 13 fath. | Surface-net.—*Stenothöe*, sp. r.; *Parathemisto*, sp. r.; *Dias longiremis*, r.; *Oithona*, sp. r.; *Caligus rapax*, r.; *Sagitta*, sp. r.; young Crustacea, f.; small Ctenophora, r. | Thornback ray, | 1 | 22 | 1 | 18 | 5 | 12 | *Loligo vulgaris*, r.; *Pecten opercularis*, f.; *Nephrops norvegicus*, fr.; *Asterias*, sp. f.; *Solaster papposa*, fr.; *Actinoloba dianthus*, r. | At beginning — Wind W.N.W., force 6; weather, overcast; sea, moderate; tide, 2½ hours flood; barometer, 29·70; transparency, 2¼ fathoms. At finish—Wind W. by N., force 6; weather, dull; sea, slight; tide, 4⅔ hours flood; barometer, 29·71; transparency, 2⅔ fathoms. |
| | | | | | ,, ,, | 3 | 9 | ... | ... | ... | ... | | |
| | | | | | Lemon soles, | 2 | 14 | 3 | 13 | 4 | 11 | | |
| | | | | | ,, ,, | 5 | 10 | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 5 | 9 | 29 | 7½ | 29 | 6½ | | |
| | | | | | ,, ,, | 5 | 5 | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 2 | 10 | 6 | 8½ | 29 | 6½ | | |
| | W. 47·7 | 48·0 | 48·3 14 fath. | Bottom-net. — *Thysanoessa*, sp. several; *Erythrops goesii*, several; *Mysis*, sp. f.; *Diastylis*, sp. f.; *Calanus finmarchicus*, fr.; *Parathemisto*, sp. fr.; *Atylus bispinosus*, f.; *Sagitta*, sp. c.; small Ctenophora, c.; young Crustacea, f.; young fish, f. | ,, ,, | 16 | 5 | ... | ... | ... | ... | | |
| | | | | | Haddocks, | 1 | 14 | 10 | 12 | 6 | 10 | | |
| | | | | | ,, | 14 | 6½ | ... | ... | ... | ... | | |
| | | | | | Cod, | 1 | 37 | 1 | 30 | 1 | 26 | | |
| | | | | | ,, | 3 | 16–22 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 19 | 13–14 | 35 | 11 | 79 | 8–9½ | | |
| | | | | | ,, | 2 | 6 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, | 3 | 5½ | ... | ... | ... | ... | | |
| | | | | | Hake, | 1 | 11 | ... | ... | ... | ... | | |
| | | | | | Anglers, | 3 | 18 | 1 | 16 | 1 | 12 | | |

TABLE C.—Record of Observations made on Board the 'Garland' during 1891.—I. Firth of Forth—*continued.*

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Water. Surface. | Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station IV. 20th Nov. 10.0 a.m. to 12 noon. | W. 46·8 | 45·4 | 45·4 5 faths. | Surface-net. — Net damaged. Bottom-net.—*Hippolyte*, sp. v.r.; *Mysis ornatus*, v.r.; *Calanus finmarchicus*, r.; *Caligus rapax*, f.; *Sagitta*, sp. f.; young Crustacea, f.; Infusoria, abundant (comprising five species of *Ceratium*, &c.). | Plaice, | 5 | 17–19 | 109 | 13–15 | 49 | 11 | *Pecten opercularis*, ab.; *Ostrea edulis*, v.r.; *Echinus esculentus*, f. | At beginning — Wind W., force 5; weather, overcast; sea, moderate; tide, 5½ hours ebb; barometer, 29·71; transparency, 1⅞ fathoms. At finish—Wind W., force 6; tide, 1¼ hours flood; barometer, 29·72; transparency, 1⅞ fathoms. |
| | | | | | „ | 35 | 9 | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 1 | 14 | 5 | 10–12 | 2 | 9 | | |
| | | | | | „ „ | 60 | 5½–7 | ... | .. | ... | ... | | |
| | | | | | Long rough dabs, | 1 | 9 | 2 | 7 | ... | ... | | |
| | E. 48·8 | 46·0 | 45·9 4 faths. | | Brill, | 1 | 12 | ... | ... | ... | ... | | |
| | | | | | Cod, | 1 | 29 | 1 | 18 | 1 | 12 | | |
| | | | | | „ | 1 | 10 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 1 | 12 | 7 | 10–11 | 3 | 8 | | |
| | | | | | „ | 2 | 5 | ... | ... | ... | ... | | |
| | | | | | Com. gurnard, | 1 | 13 | ... | ... | ... | ... | | |
| | | | | | Sprats, | 6 | 5 | 3 | 4 | ... | ... | | |
| Station V. 24th Nov. 11.0 a.m to 1.0 p.m | W. 46·0 | 47·0 | 48·5 28 faths. | Surface-net.—*Parathemisto*, sp. f.; *Calanus finmarchicus*, r.; *Centropages*, sp. r.; *Sagitta*, sp. f.; Infusoria, c.; 1 young *Motella mustela*. Bottom-net.—*Thysanöessa*, sp. f.; *Mysis spiritus*, several; *Calisoma*, sp. fr.; *Atylus bispinosus*, c.; *Parathemisto*, sp. c.; *Tauria medusarum*, f.; *Calanus finmarchicus*, c.; *Sagitta*, sp. ab.; *Tomopteris*, fr.; Ctenophora, f.; young Crustacea, fr.; young fish (Herring?), r. | Plaice, | 1 | 16 | 8 | 15 | 1 | 14 | *Loligo vulgaris*, r.; *Nephrops norvegicus*, fr.; some weed (very little in net). | At beginning—Wind variable, light; weather, very hazy sea, easterly swell; tide, 1¾ hours ebb; barometer, 29·81; transparency, 4¼ fathoms. At finish — Wind W.N.W., force 3; weather and sea as before; tide, 3¾ hours ebb; barometer, 29·80; transparency, 5¼ fathoms. |
| | | | | | „ | 1 | 11 | ... | ... | ... | .. | | |
| | | | | | Common dabs, | 2 | 10 | 10 | 7–9 | 13 | 16 | | |
| | | | | | „ „ | 6 | 4½ | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 1 | 10 | 2 | 9 | 14 | 7–8 | | |
| | E. 45·8 | 47·2 | 48·5 21 faths. | | „ „ | 50 | 4½–6 | ... | ... | ... | ... | | |
| | | | | | Haddock, | 1 | 19 | ... | ... | ... | ... | | |
| | | | | | Cod, | 1 | 17 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 1 | 13 | 2 | 11 | 1 | 9 | | |
| | | | | | Hake, | 1 | 11 | ... | ... | ... | ... | | |
| | | | | | Anglers, | 1 | 30 | 1 | 20 | ... | ... | | |

TABLE C.—Record of Observations made on Board the 'Garland' during 1891.—I. Firth of Forth—*continued.*

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Water. Surface. | Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station VI. 25th Nov. 1.45 p.m. to 2.40 p.m. | W. 42·0 | 46·8 | 48·5 13 fath. | Surface-net. — *Atylus bispinosus*, f.; *Calanus finmarchicus*, f.; *Sagitta*, sp. f.; *Tomopteris*, sp. f.; Ctenophora, f. | Plaice, | 10 | 20 | 44 | 14 | 12 | 10 | *Solaster endeca*, f.; *Echinus esculentus*, r. | At beginning—Wind S.S.W., force 5; weather, very hazy; sea, moderate; tide, 3¼ hours ebb; barometer, 29·53; transparency, 4¼ fathoms. At finish — Wind S.S.W., force 6; sea, rough; tide, 4¼ hours ebb; barometer, 29·54; transparency, 4 fathoms. |
| | | | | | ,, | 2 | 8 | 20 | 17 | ... | ... | | |
| | | | | | Lemon soles, | 2 | 15 | 1 | 14 | 2 | 13 | | |
| | | | | | ,, ,, | 3 | 11 | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 1 | 11 | 33 | 8–9 | 14 | 6 | | |
| | E. 42·5 | 47·0 | 48·2 15 fath. | Bottom-net.—*Hippolyte pusilla*, r.; *Parathemisto*, sp. f.; *Calanus finmarchicus*, fr.; *Sagitta*, sp. fr.; (comparatively little in either net). | ,, ,, | 2 | 4 | ... | ... | .. | ... | | |
| | | | | | Brill, | 1 | 22 | 1 | 21 | 1 | 14 | | |
| | | | | | Cod, | 1 | 22 | 1 | 19 | ... | ... | | |
| | | | | | Whiting, | 1 | 12 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, | 1 | 14 | 1 | 13 | 1 | 5½ | | |
| | | | | | Dragonet, | 1 | 9 | 1 | 8 | ... | ... | | |
| Station VII. 24th Nov. 2.5 p.m. to 3.50 p.m. | E. 39·5 | 45·0 | 47·6 17 fath. | Surface-net—*Idotea marina*, f.; *Mysis flexuosus*, r.; *Parathemisto*, sp. f.; Infusoria, fr.; some fragments of weed. | Plaice, | 2 | 18 | 1 | 17 | 1 | 16 | *Octopus*, sp., 1; *Asterias*, sp. fr.; *Luidia sarsii*, several; *Solaster endeca*, f.; *Echinus esculentus*, fr.; *Alcyonium*, sp. fr. | At beginning — Wind W., force 2; weather, very hazy; sea, easterly swell; tide, 5 hours ebb; barometer, 29·78; transparency, 3½ fathoms. At finish—Wind W., force 1; weather, as before; sea, slight; tide, ¾ hours flood; barometer, 29·78; transparency, 3 fathoms. |
| | | | | | ,, | 1 | 14 | ... | ... | ... | ... | | |
| | | | | | Lemon soles, | 1 | 15 | 1 | 14 | 1 | 10 | | |
| | | | | | Common dabs, | 1 | 7 | 3 | 6 | 3 | 5 | | |
| | | | | | Long rough dabs, | 1 | 9 | 1 | 8 | 5 | 7 | | |
| | W. 39·0 | 45·0 | 47·7 10 fath. | Bottom-net.—*Calisoma*, sp. r.; *Atylus bispinosus*, r.; *Parathemisto*, sp. c.; *Calanus finmarchicus*, f.; *Sagitta*, sp. ab.; *Tomopteris*, fr.; Ctenophora, fr. | ,, ,, | 3 | 6 | ... | ... | ... | ... | | |
| | | | | | Haddocks, | 1 | 22 | 1 | 19 | 1 | 15 | | |
| | | | | | ,, | 3 | 13 | 5 | 11 | 1 | 9 | | |
| | | | | | ,, | 17 | 6 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 3 | 12 | 1 | 11 | 9 | 9 | | |
| | | | | | ,, | 4 | 8 | ... | ... | ... | ... | | |
| | | | | | Angler, | 1 | 18 | ... | ... | ... | ... | | |

TABLE C.—Record of Observations made on Board the 'Garland' during 1891.—I. Firth of Forth—*continued.*

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Temperature. Water. Surface. | Temperature. Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station VIII. 23rd Nov. 10.50 a.m. to 12.45 p.m. | S.W. 48·0 | 46·1 | 48·8 20 fath. | Surface-net.—*Parathemisto*, sp. r.; *Calanus finmarchicus*, r.; *Dias*, sp. r.; *Sagitta*, sp. r.; Infusoria, fr. | Starry ray, | 1 | 10 | ... | ... | ... | ... | *Loligo*, sp., 2 (one 38 inches long, including tentacles; the other small); *Asterias*, sp. r.; *Solaster papposus*, r. | At beginning—Wind S.S.E., force 1; weather, a little hazy; sea, S.E. swell; tide, ½ hour ebb; barometer, 29·81; transparency, 4 fathoms. At finish — Sea easterly swell; tide, 4½ hours ebb; barometer, 29·81; transparency, 6½ fathoms. |
| | | | | | Plaice, | 1 | 18 | 1 | 16 | ... | ... | | |
| | | | | | Common dabs, | 3 | 8 | 1 | 5 | ... | ... | | |
| | | | | | Long rough dabs, | 2 | 7 | 3 | 5 | ... | .. | | |
| | N.E. 48·0 | 48·4 | 48·8 26 fath. | Bottom-net.—*Thysanoëssa*, sp. f.; *Mysis*, sp. r.; *Calisoma crenata*, f.; *Atylus bispinosus*, fr.; *Parathemisto*, sp. c.; *Calanus finmarchicus*, ab.; *Caligus rapax*, f.; *Sagitta*, sp. c.; *Tomopteris*, sp. r.; young Crustacea, fr. | Haddocks, | 1 | 14 | 2 | 13 | 1 | 12 | | |
| | | | | | Whitings, | 1 | 16 | 3 | 10–11 | 1 | 9 | | |
| | | | | | " | 2 | 6 | ... | ... | ... | ... | | |
| Station IX. 23rd Nov. 1.40 p.m. to 3.30 p.m. | S.E. 49·0 | 47·8 | 49·0 32 fath. | Surface-net.—*Calanus finmarchicus*, r.; *Sagitta*, sp. r.; Ctenophora, r.; 3 young *Motella mustela*. | Grey skate, | 1 | 15 | ... | ... | ... | ... | *Loligo*, sp. (juv.), f.; *Nephrops norvegicus*, fr. | At beginning—Wind W.S.W., force 2; weather, moderately clear; sea, easterly swell; tide, low water; barometer, 29·81; transparency, 6½ fathoms. At finish — Wind S.W., force 3; tide, 1½ hours flood; barometer, 29·81; transparency, 7 fathoms. |
| | | | | | Thornback ray, | 1 | 21 | ... | ... | ... | ... | | |
| | | | | | Plaice, | 1 | 18 | 1 | 16 | ... | ... | | |
| | | | | | Lemon soles, | 1 | 12 | ... | ... | ... | ... | | |
| | N.W. 49·5 | 48·2 | 49·0 27 fath. | Bottom-net. — *Calisoma crenata*, fr.; *Atylus bispinosus*, fr.; *Parathemisto*, sp. fr.; *Calanus finmarchicus*, c.; *Caligus rapax*, f.; *Sagitta*, sp. c.; *Tomopteris*, sp. fr.; young fish, v.r. | Common dabs, | 2 | 9 | 2 | 7 | 8 | 6 | | |
| | | | | | " " | 9 | 5 | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 2 | 8 | 22 | 7 | 28 | 5-6 | | |
| | | | | | " " | 1 | 3 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, | 2 | 5½ | ... | ... | ... | ... | | |
| | | | | | Angler, | 1 | 29 | ... | ... | ... | ... | | |
| Station I. 17th Dec. 1.5 p.m. to 3.15 p.m. | E. 38·0 | 7·4 | 7·5 16 fath. | | Thornback ray, | 1 | 20 | 1 | 14 | 1 | 12 | | At beginning — Wind S.W., force 2; weather, fog; sea, strong S.E. swell; |
| | | | | | " " | 1 | 9 | ... | ... | ... | ... | | |
| | | | | | Plaice, | 3 | 15 | 7 | 14 | 4 | 12 | | |
| | | | | | Lemon soles, | 2 | 13 | 14 | 12 | 6 | 10 | | |

TABLE C.—Record of Observations made on Board the 'Garland' during 1891.—I. Firth of Forth—*continued.*

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Temperature. Water. Surface. | Temperature. Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station I. 17th Dec. 1.5 p.m. to 3.15 p.m.—*continued.* | W. 40·0 | 6·8 | 7·0 12 fath. | | Lemon soles | 6 | 8 | 4 | 6 | ... | ... | | tide, about 3¼ hours flood; barometer, 30·33; transparency, 3 fathoms. At finish—Wind W.; weather, hazy; sea, strong S.E. swell; tide, 5½ hours flood; barometer, 30·32; transparency, 2 fathoms. |
| | | | | | Common dabs, | 1 | 11 | 2 | 10 | 2 | 9 | | |
| | | | | | " " | 19 | 8 | 12 | 5 | ... | ... | | |
| | | | | | Long rough dabs, | 2 | 10 | 5 | 9 | 24 | 7 | | |
| | | | | | " " | 14 | 6 | ... | ... | ... | ... | | |
| | | | | | Haddocks, | 4 | 14 | 7 | 13 | 4 | 12 | | |
| | | | | | Cod, | 1 | 27 | 2 | 24 | 1 | 19 | | |
| | | | | | " | 1 | 18 | 1 | 17 | ... | ... | | |
| | | | | | Whitings, | 1 | 14 | 2 | 13 | 12 | 12 | | |
| | | | | | " | 20 | 9 | 7 | 5 | ... | ... | | |
| | | | | | Brassie, | 1 | 7 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, | 1 | 5 | ... | ... | ... | ... | | |
| | | | | | Anglers, | 1 | 21 | 1 | 14 | ... | ... | | |
| | | | | | Pogge, | 1 | 5 | ... | ... | ... | .. | | |
| | | | | | Cat-fish, | 1 | 36 | 1 | 34 | 1 | 28 | | |
| Station II. 17th Dec. 10.45 a.m. to 12.30 p.m. | E. 40·0 | 6·1 | 7·4 12 fath. | | Starry ray, | 1 | 10 | ... | ... | ... | ... | | At beginning—Wind S., force 1; weather, hazy; sea, strong S.E. swell; tide, nearly ¼ hour flood; barometer, 30·33 transparency, 2½ fathoms. At finish — Wind N.W., force 1; weather, fog; sea, strong S.E. swell; tide, nearly ½ hour flood; barometer, 30·33; transparency, 3 fathoms. |
| | | | | | Thornback ray, | 1 | 13 | ... | ... | ... | ... | | |
| | | | | | Plaice, | 1 | 15 | 7 | 14 | 6 | 12 | | |
| | | | | | " | 2 | 10 | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 1 | 10 | 2 | 8 | 5 | 7 | | |
| | W. 39·0 | 5·8 | 7·0 12 fath. | | " | 5 | 6 | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 1 | 12 | 1 | 11 | 7 | 9 | | |
| | | | | | " " | 12 | 6 | ... | ... | ... | ... | | |
| | | | | | Haddocks, | 4 | 12 | 21 | 11 | 8 | 10 | | |
| | | | | | " | 26 | 6 | ... | ... | ... | ... | | |
| | | | | | Cod, | 1 | 15 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 16 | 10 | 11 | 8 | 6 | 7 | | |
| | | | | | " | 6 | 5 | 1 | 4 | ... | ... | | |
| | | | | | Angler, | 1 | 55 | ... | ... | ... | ... | | |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1891.—I. FIRTH OF FORTH—*continued.*

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Water. Surface. | Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION VIII. 23rd Nov. 10.50 a.m. to 12.45 p.m. | S.W. 48·0 | 46·1 | 48·8 20 fath. | Surface-net.—*Parathemisto*, sp. r.; *Calanus finmarchicus*, r.; *Dias*, sp. r.; *Sagitta*, sp. r.; Infusoria, fr. | Starry ray, | 1 | 10 | ... | ... | ... | ... | *Loligo*, sp., 2 (one 38 inches long, including tentacles; the other small); *Asterias*, sp. r.; *Solaster papposus*, r. | At beginning - Wind S.S.E., force 1; weather, a little hazy; sea, S.E. swell; tide, ½ hour ebb; barometer, 29·81; transparency, 4 fathoms. At finish Sea easterly swell; tide, 4½ hours ebb; barometer, 29·81; transparency, 6¼ fathoms. |
| | | | | | Plaice, | 1 | 18 | 1 | 16 | ... | ... | | |
| | | | | | Common dabs, | 3 | 8 | 1 | 5 | ... | ... | | |
| | | | | | Long rough dabs, | 2 | 7 | 3 | 5 | ... | ... | | |
| | N.E. 48·0 | 48·4 | 48·8 26 fath. | Bottom-net.—*Thysanoëssa*, sp. f.; *Mysis*, sp. r.; *Calisoma crenata*, f.; *Atylus bispinosus*, fr.; *Parathemisto*, sp. c.; *Calanus finmarchicus*, ab.; *Caligus rapax*, f.; *Sagitta*, sp. c.; *Tomopteris*, sp. r.; young Crustacea, fr. | Haddocks, | 1 | 14 | 2 | 13 | 1 | 12 | | |
| | | | | | Whitings, | 1 | 16 | 3 | 10-11 | 1 | 9 | | |
| | | | | | ,, | 2 | 6 | ... | ... | ... | ... | | |
| [...]ON IX. [...] Nov. | S.E. 49·0 | 47·8 | 49·0 32 fath. | Surface-net.—*Calanus finmarchicus*, r.; *Sagitta*, sp. r.; Ctenophora, r.; 3 young *Motella mustela*. | Grey skate, | 1 | 15 | ... | ... | ... | ... | *Loligo*, sp. (juv.), f.; *Nephrops norvegicus*, fr. | At beginning - Wind W.S.W., force 2; weather, moderately clear; sea, easterly swell; tide, low water; barometer, 29·81; transparency, 6¼ fathoms. At finish — Wind S.W., force 3; tide, 1¼ hours flood; barometer, 29·81; transparency, 7 fathoms. |
| | | | | | Thornback ray, | 1 | 21 | ... | ... | ... | ... | | |
| | | | | | Plaice, | 1 | 18 | 1 | 16 | ... | ... | | |
| | | | | | Lemon soles, | 1 | 12 | ... | ... | ... | ... | | |
| | N.W. 49·5 | 48·2 | 49·0 27 fath. | Bottom-net. — *Calisoma crenata*, fr.; *Atylus bispinosus*, fr.; *Parathemisto*, sp. fr.; *Calanus finmarchicus*, c.; *Caligus rapax*, f.; *Sagitta*, sp. c.; *Tomopteris*, sp. fr.; young fish, v.r. | Common dabs, | 2 | 9 | 2 | 7 | 8 | 6 | | |
| | | | | | ,, ,, | 9 | 5 | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 2 | 8 | 22 | 7 | 28 | 5-6 | | |
| | | | | | ,, ,, | 1 | 8 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, | 2 | 5½ | ... | ... | ... | ... | | |
| | | | | | Angler, | 1 | 29 | ... | ... | ... | ... | | |
| | [...]0 | 7·4 | 7·5 16 fath. | | Thornback ray, | 1 | 20 | 1 | 14 | 1 | 12 | | At beginning — Wind S.W., force 2; weather, fog; sea, strong S.E. swell; |
| | | | | | ,, ,, | 1 | 9 | ... | ... | ... | ... | | |
| | | | | | Plaice, | 8 | 15 | 7 | 14 | 4 | 12 | | |
| | | | | | Lemon soles, | 2 | 18 | 14 | 12 | 6 | 10 | | |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1891.—I. FIRTH OF FORTH—*continued*.

| Date and Time Trawl down. | Temperature. Air. Dry Bulb. | Water. Surface. | Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [illegible] | W. 40·0 | 6·8 | 7·0 12 fath. | | Lemon soles . | 6 | 8 | 4 | 6 | ... | ... | | tide, about 8¼ hours flood; barometer, 30·33; transparency, 8 fathoms. At finish—Wind W.; weather, hazy; sea, strong S.E. swell; tide, 5¼ hours flood; barometer, 30·32; transparency, 9 fathoms. |
| | | | | | | 1 | 11 | 2 | 10 | 2 | 9 | | |
| | | | | | Common dabs, . | 19 | 8 | 12 | 5 | ... | ... | | |
| | | | | | " " . | 2 | 10 | 5 | 9 | 24 | 7 | | |
| | | | | | Long rough dabs, | 14 | 6 | ... | ... | ... | ... | | |
| | | | | | " " . | 4 | 14 | 7 | 13 | 4 | 12 | | |
| | | | | | Haddocks, . | 1 | 27 | 2 | 24 | 1 | 19 | | |
| | | | | | Cod, . | 1 | 18 | 1 | 17 | ... | ... | | |
| | | | | | " . | 1 | 14 | 2 | 13 | 12 | 12 | | |
| | | | | | Whitings, . | 20 | 9 | 7 | 6 | ... | ... | | |
| | | | | | " . | 1 | 7 | ... | ... | ... | ... | | |
| | | | | | Brassie, . | 1 | 6 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, . | 1 | 21 | 1 | 14 | ... | ... | | |
| | | | | | Anglers, . | 1 | 6 | ... | ... | ... | ... | | |
| | | | | | Pogge, . | 1 | 36 | 1 | 34 | 1 | 28 | | |
| | | | | | Cat-fish, . | | | | | | | | |
| [illegible] | [illegible] | [illegible] | [illegible] | | Starry ray, . | 1 | 10 | ... | ... | ... | ... | | At beginning—Wind [illegible] |
| | | | | | Thornback ray, . | 1 | 13 | [illegible] | [illegible] | [illegible] | [illegible] | | |
| | | | | | Plaice, . | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | | |
| | | | | | Common dabs, . | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | | |
| | | | | | Long rough dabs, . | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | | |
| | | | | | Haddocks, . | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | | |
| | | | | | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | | |
| | | | | | Whitings, . | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | | |
| | | | | | Anglers, . | 1 | 36 | ... | ... | ... | ... | | |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1891.—I. FIRTH OF FORTH—*continued.*

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Temperature. Water. Surface. | Temperature. Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION III. 24th Dec. 10.20 a.m. to 12.10 p.m. | W. 39·0 | 6·1c | 7·1c 9 fath. | Surface-net. — *Parathemisto*, sp. c.; *Calanus finmarchicus*, f. Bottom-net. — *Boreophausia*, sp. fr.; *Parathemisto*, sp. c.; *Hyperia*, sp. r.; *Calanus finmarchicus*, c.; *Sagitta*, sp. c.; *Caligus*, sp. r. | Thornback ray, . | 2 | 18 | 1 | 14 | ... | ... | *Pecten opercularis*, f.; *Loligo vulgaris*, r.; *Echinus esculentus*, f.; *Solaster papposa*, f.; *Solaster endeca*, f.; *Asterias*, sp. f.; *Ophiothrix rosula*, f.; *Actinoloba dianthus*, fr. | At beginning — Wind W., force 5; weather, light fog; sea, moderate; tide, 1¼ hours ebb; barometer, 30·14; transparency, 2½ fathoms. At finish—Wind, weather and sea as before; tide, 3 hours ebb; barometer, 30·13; transparency, 3 fathoms. |
| | | | | | Lemon soles, . | 1 | 15 | 1 | 14 | 3 | 11-12 | | |
| | | | | | ,, ,, . | 1 | 10 | ... | ... | ... | ... | | |
| | | | | | Common dabs, . | 1 | 10 | 1 | 9 | 7 | 8 | | |
| | | | | | ,, ,, . | 23 | 5-6 | ... | ... | ... | ... | | |
| | E. 39·0 | 6·5c | 7·0c 11 fath. | | Long rough dabs, | 3 | 9 | 2 | 8 | 9 | 7 | | |
| | | | | | ,, ,, . | 7 | 5 | ... | ... | ... | ... | | |
| | | | | | Haddocks, . . | 1 | 13 | 2 | 12 | 1 | 10 | | |
| | | | | | ,, . . | 18 | 6 | ... | ... | ... | ... | | |
| | | | | | Cod, . . . | 1 | 41 | 3 | 16 | 1 | 15 | | |
| | | | | | ,, . . . | 1 | 11 | ... | ... | ... | ... | | |
| | | | | | Ling, . . . | 1 | 21 | ... | ... | ... | ... | | |
| | | | | | Whitings, . . | 3 | 13½ | 22 | 11½ | 16 | 9 | | |
| | | | | | ,, . . . | 4 | 8 | ... | ... | ... | ... | | |
| | | | | | Brassie, . . | 2 | 7 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, . | 1 | 8 | 1 | 4 | ... | ... | | |
| | | | | | Anglers, . . | 1 | 26 | 1 | 17 | ... | ... | | |
| STATION IV. 18th Dec. 10.50 a.m. to 2.10 p.m. | E. 41·0 | 6·5 | 6·6 8 fath. | | Plaice, . . | 2 | 16 | 3 | 15 | 13 | 14 | | At beginning — Wind S.W., force 2; weather, hazy; sea, slight E. swell; tide, nearly 1 hour flood; barometer, 30·36; transparency, 2 fathoms. At finish—Wind S., force 2; weather, dull and hazy; sea, |
| | | | | | ,, . . | 8 | 13 | 2 | 11 | ... | ... | | |
| | | | | | Lemon sole, . | 1 | 11 | 3 | 10 | 4 | 9 | | |
| | | | | | ,, ,, . | 4 | 8 | 3 | 6 | ... | ... | | |
| | | | | | Common dabs, . | 1 | 13 | 4 | 10 | 11 | 9 | | |
| | W. 43·0 | 6·3 | 6·5 6 fath. | | ,, ,, . | 41 | 8 | 49 | 7 | 25 | 5 | | |
| | | | | | ,, ,, . | 4 | 4 | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 4 | 10 | 11 | 9 | 22 | 8 | | |
| | | | | | ,, ,, . | 8 | 6 | 3 | 5 | ... | ... | | |
| | | | | | Haddock, . . | 1 | 6 | ... | ... | ... | ... | | |
| | | | | | Cod, . . . | 1 | 30 | 1 | 23 | 1 | 22 | | |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD 'THE GARLAND' DURING 1891.—I. FIRTH OF FORTH—*continued.*

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Temperature. Water. Surface. | Temperature. Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION IV. 18th Dec. 10.50 a.m. to 2.10 p.m. —*continued.* | | | | | Cod, | 2 | 20 | 4 | 16 | 2 | 13 | | smooth; tide, nearly ¾ flood; barometer, 30·34; transparency, 2¾ fathoms. |
| | | | | | " | 7 | 12 | 1 | 7 | ... | ... | | |
| | | | | | Whitings, | 2 | 13 | 37 | 12 | 37 | 9 | | |
| | | | | | " | 45 | 8 | 23 | 6 | 6 | 5 | | |
| | | | | | Anglers, | 1 | 18 | 2 | 16 | 3 | 13 | | |
| STATION V. 23rd Dec. 10.45 a.m to 1.10 p.m. | W. 42·5 | 7·4c | 7·6c 29 fath. | Surface-net.—*Tauria*, sp. r.; *Parathemisto*, sp. f.; *Calanus finmarchicus*, f.; *Sagitta*, sp. f. | Thornback ray, | 1 | 11 | ... | ... | ... | ... | *Octopus vulgaris*, 1; *Loligo vulgaris*, 2; *Nephrops norvegicus*, r.; *Asterias*, sp. r. | At beginning — Wind W., force 5; weather, hazy; sea, slight; tide, 2¾ hours ebb; barometer, 30·33; transparency, 5 fathoms. At finish—Wind W.S.W., force 4; weather and sea as before; tide, 5¾ hours ebb; barometer, 30·33; transparency, 6 fathoms. |
| | | | | | Plaice, | 3 | 16 | 1 | 14 | 1 | 13 | | |
| | | | | | Common dabs, | 1 | 10 | 1 | 8 | 3 | 7 | | |
| | | | | | " | 3 | 6 | ... | ... | ... | ... | | |
| | E. 43·0 | 7·4c | 7·7c 23 fath. | Bottom-net. — *Parathemisto*, sp. ab.; *Atylus bispinosus*, fr.; *Calisoma crenata*, f.; *Calanus finmarchicus*, c.; *Sagitta*, sp. ab. | Long rough dabs, | 3 | 9 | 11 | 7½ | 11 | 5 | | |
| | | | | | Haddocks, | 3 | 6 | ... | ... | ... | ... | | |
| | | | | | Cod, | 1 | 22 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 2 | 17 | 1 | 15 | 1 | 11 | | |
| | | | | | " | 2 | 10 | ... | ... | ... | ... | | |
| | | | | | Hake, | 1 | 17 | ... | ... | ... | ... | | |
| | | | | | Anglers, | 1 | 25 | 1 | 19 | ... | ... | | |
| | | | | | Dragonet, | 1 | 6 | ... | ... | ... | ... | | |
| STATION VI. 33rd Dec. 2.30 p.m. to 3.20 p.m. | E. 41·0 | 7·1c | 7·2c 12½ fath. | Surface-net. — *Parathemisto*, sp. f.; *Sagitta*, sp. r.; small Ctenophores, f. | Plaice, | 3 | 18½ | 14 | 17 | 33 | 16 | *Octopus vulgaris*, 2; *Echinus esculentus*, several; *Asterias*, sp. fr.; *Ophioglypha albida*, fr. | At beginning — Wind N.W., force 2; weather, fog; sea, slight; tide, low water; barometer, 30·29; transparency, 4½ fathoms. At finish—Wind |
| | | | | | " | 4 | 11 | ... | ... | ... | ... | | |
| | | | | | Lemon soles, | 2 | 14 | 1 | 13 | 4 | 12 | | |
| | | | | | Common dabs, | 3 | 10 | 5 | 8 | 5 | 7 | | |
| | | | | | " | 17 | 5-6 | ... | ... | ... | ... | | |
| | W. 40·5 | 7·2c | 7·5c 18½ fath. | Bottom-net. — *Calanus finmarchicus*, fr.; *Sagitta*, sp. c. | Long rough dabs, | 1 | 8 | 2 | 7 | 1 | 6 | | |
| | | | | | Turbot, | 1 | 25 | ... | ... | ... | ... | | |
| | | | | | Brill, | 1 | 25 | 1 | 24 | 1 | 21 | | |

TABLE C.—Record of Observations made on Board the 'Garland' during 1891.—I. Firth of Forth—*continued.*

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Water. Surface. | Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station III. 24th Dec. 10.20 a.m. to 12.10 p.m. | W. 39·0 | 6·1c | 7·1c 9 fath. | Surface-net. — *Parathemisto*, sp. c.; *Calanus finmarchicus*, f. Bottom-net. — *Boreophausia*, sp. fr.; *Parathemisto*, sp. c.; *Hyperia*, sp. r.; *Calanus finmarchicus*, c.; *Sagitta*, sp. c.; *Caligus*, sp. r. | Thornback ray, | 2 | 18 | 1 | 14 | ... | ... | *Pecten opercularis*, f.; *Loligo vulgaris*, r.; *Echinus esculentus*, f.; *Solaster papposa*, f.; *Solaster endeca*, f.; *Asterias*, sp. f.; *Ophiothrix rosula*, f.; *Actinoloba dianthus*, fr. | At beginning — Wind W., force 5; weather, light fog; sea, moderate; tide, 1½ hours ebb; barometer, 30·14; transparency, 2½ fathoms. At finish—Wind, weather and sea as before; tide, 3 hours ebb; barometer, 30·13; transparency, 3 fathoms. |
| | | | | | Lemon soles, | 1 | 15 | 1 | 14 | 3 | 11-12 | | |
| | | | | | " " | 1 | 10 | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 1 | 10 | 1 | 9 | 7 | 8 | | |
| | | | | | " " | 23 | 5-6 | ... | ... | ... | ... | | |
| | E. 39·0 | 6·5c | 7·0c 11 fath. | | Long rough dabs, | 3 | 9 | 2 | 8 | 9 | 7 | | |
| | | | | | " " | 7 | 5 | ... | ... | ... | ... | | |
| | | | | | Haddocks, | 1 | 18 | 2 | 12 | 1 | 10 | | |
| | | | | | " | 18 | 6 | ... | ... | ... | ... | | |
| | | | | | Cod, | 1 | 41 | 3 | 16 | 1 | 15 | | |
| | | | | | " | 1 | 11 | ... | ... | ... | ... | | |
| | | | | | Ling, | 1 | 21 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 3 | 13½ | 22 | 11½ | 16 | 9 | | |
| | | | | | " | 4 | 8 | ... | ... | ... | ... | | |
| | | | | | Brassie, | 2 | 7 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, | 1 | 8 | 1 | 4 | ... | ... | | |
| | | | | | Anglers, | 1 | 26 | 1 | 17 | ... | ... | | |
| Station IV. 18th Dec. 10.50 a.m. to 2.10 p.m. | E. 41·0 | 6·5 | 6·6 8 fath. | | Plaice, | 2 | 16 | 3 | 15 | 13 | 14 | | At beginning — Wind S.W., force 2; weather, hazy; sea, slight E. swell; tide, nearly 1 hour flood; barometer, 30·36; transparency, 2 fathoms. At finish—Wind S., force 2; weather, dull and hazy; sea, |
| | | | | | " | 8 | 13 | 2 | 11 | ... | ... | | |
| | | | | | Lemon sole, | 1 | 11 | 3 | 10 | 4 | 9 | | |
| | | | | | " " | 4 | 8 | 3 | 6 | ... | ... | | |
| | | | | | Common dabs, | 1 | 13 | 4 | 10 | 11 | 9 | | |
| | W. 43·0 | 6·3 | 6·5 6 fath. | | " " | 41 | 8 | 49 | 7 | 25 | 5 | | |
| | | | | | " " | 4 | 4 | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 4 | 10 | 11 | 9 | 22 | 8 | | |
| | | | | | " " | 8 | 6 | 3 | 5 | ... | ... | | |
| | | | | | Haddock, | 1 | 6 | ... | ... | ... | ... | | |
| | | | | | Cod, | 1 | 30 | 1 | 23 | 1 | 22 | | |

TABLE C.—Record of Observations made on Board 'the Garland' during 1891.—I. Firth of Forth—*continued*.

| Station, Date, and Time Trawl down. | Temperature. | | | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. | | | | | | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Air. | Water. | | | | | | | | | | | |
| | Dry Bulb. | Surface. | Bottom. | | | No. | Inches | No. | Inches | No. | Inches | | |
| Station IV.<br>18th Dec.<br>10.50 a.m. to<br>2.10 p.m.<br>—*continued*. | | | | | Cod, | 2 | 20 | 4 | 16 | 2 | 13 | | smooth; tide, nearly ¾ flood; barometer, 30·34; transparency, 2¾ fathoms. |
| | | | | | ,, | 7 | 12 | 1 | 7 | ... | ... | | |
| | | | | | Whitings, | 2 | 13 | 37 | 12 | 37 | 9 | | |
| | | | | | ,, | 45 | 8 | 23 | 6 | 6 | 5 | | |
| | | | | | Anglers, | 1 | 18 | 2 | 16 | 3 | 13 | | |
| Station V.<br>23rd Dec.<br>10.45 a.m to<br>1.10 p.m. | W. 42·5 | 7·4c | 7·6c<br>29<br>fath. | Surface-net.—*Tauria*, sp. r.; *Parathemisto*, sp. f.; *Calanus finmarchicus*, f.; *Sagitta*, sp. f. | Thornback ray, | 1 | 11 | ... | ... | .. | ... | *Octopus vulgaris*, 1; *Loligo vulgaris*, 2; *Nephrops norvegicus*, r.; *Asterias*, sp. r. | At beginning — Wind W., force 5; weather, hazy; sea, slight; tide, 2¾ hours ebb; barometer, 30·33; transparency, 5 fathoms. |
| | | | | | Plaice, | 3 | 16 | 1 | 14 | 1 | 13 | | |
| | | | | | Common dabs, | 1 | 10 | 1 | 8 | 3 | 7 | | |
| | | | | | ,, | 3 | 6 | ... | ... | ... | ... | | |
| | E. 43·0 | 7·4c | 7·7c<br>23<br>fath. | Bottom-net. — *Parathemisto*, sp. ab.; *Atylus bispinosus*, fr.; *Calisoma crenata*, f.; *Calanus finmarchicus*, c.; *Sagitta*, sp. ab. | Long rough dabs, | 3 | 9 | 11 | 7½ | 11 | 5 | | At finish—Wind W.S.W., force 4; weather and sea as before; tide, 5¾ hours ebb; barometer, 30·33; transparency, 6 fathoms. |
| | | | | | Haddocks, | 3 | 6 | ... | ... | ... | ... | | |
| | | | | | Cod, | 1 | 22 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 2 | 17 | 1 | 15 | 1 | 11 | | |
| | | | | | ,, | 2 | 10 | ... | ... | ... | ... | | |
| | | | | | Hake, | 1 | 17 | ... | ... | ... | ... | | |
| | | | | | Anglers, | 1 | 25 | 1 | 19 | ... | ... | | |
| | | | | | Dragonet, | 1 | 6 | ... | ... | ... | ... | | |
| | | | | | | | | ... | ... | ... | ... | | |
| | | | | | | | | ... | ... | ... | ... | | |
| Station VI.<br>33rd Dec.<br>2.30 p.m. to<br>3.20 p.m. | E. 41·0 | 7·1c | 7·2c<br>12½<br>fath. | Surface-net. — *Parathemisto*, sp. f.; *Sagitta*, sp. r.; small Ctenophores, f. | Plaice, | 3 | 18½ | 14 | 17 | 33 | 16 | *Octopus vulgaris*, 2; *Echinus esculentus*, several; *Asterias*, sp. fr.; *Ophioglypha albida*, fr. | At beginning — Wind N.W., force 2; weather, fog; sea, slight; tide, low water; barometer, 30·29; transparency, 4½ fathoms. |
| | | | | | ,, | 4 | 11 | ... | ... | ... | ... | | |
| | | | | | Lemon soles, | 2 | 14 | 1 | 13 | 4 | 12 | | |
| | | | | | Common dabs, | 3 | 10 | 5 | 8 | 5 | 7 | | |
| | | | | | ,, ,, | 17 | 5–6 | ... | ... | ... | ... | | |
| | W. 40·5 | 7·2c | 7·5c<br>18½<br>fath. | Bottom-net. — *Calanus finmarchicus*, fr.; *Sagitta*, sp. c. | Long rough dabs, | 1 | 8 | 2 | 7 | 1 | 6 | | At finish—Wind |
| | | | | | Turbot, | 1 | 25 | ... | ... | ... | ... | | |
| | | | | | Brill, | 1 | 25 | 1 | 24 | 1 | 21 | | |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1891.—I. FIRTH OF FORTH—*continued.*

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Temperature. Water. Surface. | Temperature. Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION III. 24th Dec. 10.20 a.m. to 12.10 p.m. | W. 39·0 | 6·1c | 7·1c 9 fath. | Surface-net. — *Parathemisto*, sp. c.; *Calanus finmarchicus*, f. Bottom-net. — *Boreophausia*, sp. fr.; *Parathemisto*, sp. c.; *Hyperia*, sp. r.; *Calanus finmarchicus*, c.; *Sagitta*, sp. c.; *Caligus*, sp. r. | Thornback ray, . | 2 | 18 | 1 | 14 | ... | ... | *Pecten opercularis*, f.; *Loligo vulgaris*, r.; *Echinus esculentus*, f.; *Solaster papposa*, f.; *Solaster endeca*, f.; *Asterias*, sp. f.; *Ophiothrix rosula*, f.; *Actinoloba dianthus*, fr. | At beginning — Wind W., force 5; weather, light fog; sea, moderate; tide, 1¼ hours ebb; barometer, 30·14; transparency, 2½ fathoms. At finish—Wind, weather and sea as before; tide, 3 hours ebb; barometer, 30·13; transparency, 3 fathoms. |
| | | | | | Lemon soles, . | 1 | 15 | 1 | 14 | 3 | 11-12 | | |
| | | | | | " " . | 1 | 10 | ... | ... | ... | ... | | |
| | | | | | Common dabs, . | 1 | 10 | 1 | 9 | 7 | 8 | | |
| | | | | | " " . | 23 | 5–6 | ... | ... | ... | ... | | |
| | E. 39·0 | 6·5c | 7·0c 11 fath. | | Long rough dabs, | 3 | 9 | 2 | 8 | 9 | 7 | | |
| | | | | | " " . | 7 | 5 | ... | ... | ... | ... | | |
| | | | | | Haddocks, . . | 1 | 18 | 2 | 12 | 1 | 10 | | |
| | | | | | " . . . | 18 | 6 | ... | ... | ... | ... | | |
| | | | | | Cod, . . . | 1 | 41 | 3 | 16 | 1 | 15 | | |
| | | | | | " . . . | 1 | 11 | ... | ... | ... | ... | | |
| | | | | | Ling, . . . | 1 | 21 | ... | ... | ... | ... | | |
| | | | | | Whitings, . . | 3 | 13½ | 22 | 11½ | 16 | 9 | | |
| | | | | | " . . . | 4 | 8 | ... | ... | ... | ... | | |
| | | | | | Brassie, . . | 2 | 7 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, . | 1 | 8 | 1 | 4 | ... | ... | | |
| | | | | | Anglers, . . | 1 | 26 | 1 | 17 | ... | ... | | |
| STATION IV. 18th Dec. 10.50 a.m. to 2.10 p.m. | E. 41·0 | 6·5 | 6·6 8 fath. | | Plaice, . . | 2 | 16 | 3 | 15 | 13 | 14 | | At beginning — Wind S.W., force 2; weather, hazy; sea, slight E. swell; tide, nearly 1 hour flood; barometer, 30·36; transparency, 2 fathoms. At finish—Wind S., force 2; weather, dull and hazy; sea, |
| | | | | | " . . . | 8 | 13 | 2 | 11 | ... | ... | | |
| | | | | | Lemon sole, . | 1 | 11 | 3 | 10 | 4 | 9 | | |
| | | | | | " " . | 4 | 8 | 3 | 6 | ... | ... | | |
| | | | | | Common dabs, . | 1 | 13 | 4 | 10 | 11 | 9 | | |
| | W. 43·0 | 6·3 | 6·5 6 fath. | | " " . | 41 | 8 | 49 | 7 | 25 | 5 | | |
| | | | | | " " . | 4 | 4 | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 4 | 10 | 11 | 9 | 22 | 8 | | |
| | | | | | " " . | 8 | 6 | 3 | 5 | ... | ... | | |
| | | | | | Haddock, . . | 1 | 6 | ... | ... | ... | ... | | |
| | | | | | Cod, . . . | 1 | 30 | 1 | 23 | 1 | 22 | | |

TABLE C.—Record of Observations made on Board 'the Garland' during 1891.—I. Firth of Forth—*continued*.

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Temperature. Water. Surface. | Temperature. Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station IV. 18th Dec. 10.50 a.m. to 2.10 p.m. —*continued*. | | | | | Cod, | 2 | 20 | 4 | 16 | 2 | 13 | | smooth; tide, nearly ¾ flood; barometer, 30·34; transparency, 2¾ fathoms. |
| | | | | | ,, | 7 | 12 | 1 | 7 | ... | ... | | |
| | | | | | Whitings, | 2 | 13 | 37 | 12 | 37 | 9 | | |
| | | | | | ,, | 45 | 8 | 23 | 6 | 6 | 5 | | |
| | | | | | Anglers, | 1 | 18 | 2 | 16 | 3 | 13 | | |
| Station V. 23rd Dec. 10.45 a.m to 1.10 p.m. | W. 42·5 | 7·4c | 7·6c 29 fath. | Surface-net.—*Tauria*, sp. r.; *Parathemisto*, sp. f.; *Calanus finmarchicus*, f.; *Sagitta*, sp. f. | Thornback ray, | 1 | 11 | ... | ... | .. | ... | *Octopus vulgaris*, 1; *Loligo vulgaris*, 2; *Nephrops norvegicus*, r.; *Asterias*, sp. r. | At beginning — Wind W., force 5; weather, hazy; sea, slight; tide, 2¼ hours ebb; barometer, 30·33; transparency, 5 fathoms. At finish—Wind W.S.W., force 4; weather and sea as before; tide, 5¾ hours ebb; barometer, 30·33; transparency, 6 fathoms. |
| | | | | | Plaice, | 3 | 16 | 1 | 14 | 1 | 13 | | |
| | | | | | Common dabs, | 1 | 10 | 1 | 8 | 3 | 7 | | |
| | | | | | ,, | 3 | 6 | ... | ... | ... | ... | | |
| | E. 43·0 | 7·4c | 7·7c 23 fath. | Bottom-net. — *Parathemisto*, sp. ab.; *Atylus bispinosus*, fr.; *Calisoma crenata*, f.; *Calanus finmarchicus*, c.; *Sagitta*, sp. ab. | Long rough dabs, | 3 | 9 | 11 | 7½ | 11 | 5 | | |
| | | | | | Haddocks, | 3 | 6 | ... | ... | ... | ... | | |
| | | | | | Cod, | 1 | 22 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 2 | 17 | 1 | 15 | 1 | 11 | | |
| | | | | | ,, | 2 | 10 | ... | ... | ... | ... | | |
| | | | | | Hake, | 1 | 17 | ... | ... | ... | ... | | |
| | | | | | Anglers, | 1 | 25 | 1 | 19 | ... | ... | | |
| | | | | | Dragonet, | 1 | 6 | ... | ... | ... | ... | | |
| Station VI. 33rd Dec. 2.30 p.m. to 3.20 p.m. | E. 41·0 | 7·1c | 7·2c 12½ fath. | Surface-net. — *Parathemisto*, sp. f.; *Sagitta*, sp. r.; small Ctenophores, f. | Plaice, | 3 | 18½ | 14 | 17 | 33 | 16 | *Octopus vulgaris*, 2; *Echinus esculentus*, several; *Asterias*, sp. fr.; *Ophioglypha albida*, fr. | At beginning — Wind N.W., force 2; weather, fog; sea, slight; tide, low water; barometer, 30·29; transparency, 4½ fathoms. At finish—Wind |
| | | | | | ,, | 4 | 11 | ... | ... | ... | ... | | |
| | | | | | Lemon soles, | 2 | 14 | 1 | 13 | 4 | 12 | | |
| | | | | | Common dabs, | 3 | 10 | 5 | 8 | 5 | 7 | | |
| | | | | | ,, ,, | 17 | 5–6 | ... | ... | ... | ... | | |
| | W. 40·5 | 7·2c | 7·5c 18½ fath. | Bottom-net. — *Calanus finmarchicus*, fr.; *Sagitta*, sp. c. | Long rough dabs, | 1 | 8 | 2 | 7 | 1 | 6 | | |
| | | | | | Turbot, | 1 | 25 | ... | ... | ... | ... | | |
| | | | | | Brill, | 1 | 25 | 1 | 24 | 1 | 21 | | |

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TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1891.—I. FIRTH OF FORTH—*continued.*

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Water. Surface. | Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION IV. 20th Nov. 10.0 a.m. to 12 noon. | W. 46·8 | 45·4 | 45·4 5 faths. | Surface-net. — Net damaged. Bottom-net.—*Hippolyte*, sp. v.r.; *Mysis ornatus*, v.r.; *Calanus finmarchicus*, r.; *Caligus rapax*, f.; *Sagitta*, sp. f.; young Crustacea, f.; Infusoria, abundant (comprising five species of *Ceratium*, &c.). | Plaice, . . | 5 | 17–19 | 109 | 13–15 | 49 | 11 | *Pecten opercularis*, ab.; *Ostrea edulis*, v.r.; *Echinus esculentus*, f. | At beginning — Wind W., force 5; weather, overcast; sea, moderate; tide, 5¼ hours ebb; barometer, 29·71; transparency, 1⅜ fathoms. At finish—Wind W., force 6; tide, 1¼ hours flood; barometer, 29·72; transparency, 1⅜ fathoms. |
| | | | | | " . . | 35 | 9 | ... | ... | ... | ... | | |
| | | | | | Common dabs, . | 1 | 14 | 5 | 10–12 | 2 | 9 | | |
| | | | | | " " . | 60 | 5½–7 | ... | .. | ... | ... | | |
| | | | | | Long rough dabs, | 1 | 9 | 2 | 7 | ... | ... | | |
| | E. 48·8 | 46·0 | 45·9 4 faths. | | Brill, . . . | 1 | 12 | ... | ... | ... | ... | | |
| | | | | | Cod, . . . | 1 | 29 | 1 | 18 | 1 | 12 | | |
| | | | | | " . . . | 1 | 10 | ... | ... | ... | ... | | |
| | | | | | Whitings, . . | 1 | 12 | 7 | 10–11 | 3 | 8 | | |
| | | | | | " . . | 2 | 5 | ... | ... | ... | ... | | |
| | | | | | Com. gurnard, . | 1 | 13 | ... | ... | ... | ... | | |
| | | | | | Sprats, . . | 6 | 5 | 3 | 4 | ... | ... | | |
| STATION V. 24th Nov. 11.0 a.m to 1.0 p.m | W. 46·0 | 47·0 | 48·5 28 faths. | Surface-net.—*Parathemisto*, sp. f.; *Calanus finmarchicus*, r.; *Centropages*, sp. r.; *Sagitta*, sp. f.; Infusoria, c.; 1 young *Motella mustela*. Bottom-net.—*Thysanöessa*, sp. f.; *Mysis spiritus*, several; *Calisoma*, sp. fr.; *Atylus bispinosus*, c.; *Parathemisto*, sp. c.; *Tauria medusarum*, f.; *Calanus finmarchicus*, c.; *Sagitta*, sp. ab.; *Tomopteris*, fr.; Ctenophora, f.; young Crustacea, fr.; young fish (Herring?), r. | Plaice, . . | 1 | 16 | 3 | 15 | 1 | 14 | *Loligo vulgaris*, r.; *Nephrops norvegicus*, fr.; some weed (very little in net). | At beginning—Wind variable, light; weather, very hazy sea, easterly swell; tide, 1¾ hours ebb; barometer, 29·81; transparency, 4¼ fathoms. At finish — Wind W.N.W., force 3; weather and sea as before; tide, 3¾ hours ebb; barometer, 29·80; transparency, 5¼ fathoms. |
| | | | | | " . . | 1 | 11 | ... | ... | ... | .. | | |
| | | | | | Common dabs, . | 2 | 10 | 10 | 7–9 | 13 | 16 | | |
| | | | | | " " | 6 | 4½ | ... | ... | ... | ... | | |
| | E. 45·8 | 47·2 | 48·5 21 faths. | | Long rough dabs, | 1 | 10 | 2 | 9 | 14 | 7–8 | | |
| | | | | | " " | 50 | 4½–6 | ... | ... | ... | ... | | |
| | | | | | Haddock, . . | 1 | 19 | ... | ... | ... | ... | | |
| | | | | | Cod, . . . | 1 | 17 | ... | ... | ... | ... | | |
| | | | | | Whitings, . . | 1 | 13 | 2 | 11 | 1 | 9 | | |
| | | | | | Hake, . . | 1 | 11 | ... | ... | ... | ... | | |
| | | | | | Anglers, . . | 1 | 30 | 1 | 20 | ... | ... | | |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1891.—I. FIRTH OF FORTH—*continued*.

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Temperature. Water. Surface. | Temperature. Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION VI. 25th Nov. 1.45 p.m. to 2.40 p.m. | W. 42·0<br>E. 42·5 | 46·8<br>47·0 | 48·5 13 fath.<br>48·2 15 fath. | Surface-net. — *Atylus bispinosus*, f.; *Calanus finmarchicus*, f.; *Sagitta*, sp. f.; *Tomopteris*, sp. f.; Ctenophora, f. Bottom-net.—*Hippolyte pusilla*, r.; *Parathemisto*, sp. f.; *Calanus finmarchicus*, fr.; *Sagitta*, sp. fr.; (comparatively little in either net). | Plaice, | 10 | 20 | 44 | 14 | 12 | 10 | *Solaster endeca*, f.; *Echinus esculentus*, r. | At beginning—Wind S.S.W., force 5; weather, very hazy; sea, moderate; tide, 3¼ hours ebb; barometer, 29·53; transparency, 4½ fathoms. At finish — Wind S.S.W., force 6; sea, rough; tide, 4¼ hours ebb; barometer, 29·54; transparency, 4 fathoms. |
| | | | | | ,, | 2 | 8 | 20 | 17 | ... | ... | | |
| | | | | | Lemon soles, | 2 | 15 | 1 | 14 | 2 | 13 | | |
| | | | | | ,, ,, | 3 | 11 | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 1 | 11 | 33 | 8–9 | 14 | 6 | | |
| | | | | | ,, ,, | 2 | 4 | ... | ... | .. | ... | | |
| | | | | | Brill, | 1 | 22 | 1 | 21 | 1 | 14 | | |
| | | | | | Cod, | 1 | 22 | 1 | 19 | ... | ... | | |
| | | | | | Whiting, | 1 | 12 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, | 1 | 14 | 1 | 13 | 1 | 5½ | | |
| | | | | | Dragonet, | 1 | 9 | 1 | 8 | ... | ... | | |
| STATION VII. 24th Nov. 2.5 p.m. to 3.50 p.m. | E. 39·5<br>W. 39·0 | 45·0<br>45·0 | 47·6 17 fath.<br>47·7 10 fath. | Surface-net—*Idotea marina*, f.; *Mysis flexuosus*, r.; *Parathemisto*, sp. f.; Infusoria, fr.; some fragments of weed. Bottom-net.—*Calisoma*, sp. r.; *Atylus bispinosus*, r.; *Parathemisto*, sp. c.; *Calanus finmarchicus*, f.; *Sagitta*, sp. ab.; *Tomopteris*, fr.; Ctenophora, fr. | Plaice, | 2 | 18 | 1 | 17 | 1 | 16 | *Octopus*, sp., 1; *Asterias*, sp. fr.; *Luidia sarsii*, several; *Solaster endeca*, f.; *Echinus esculentus*, fr.; *Alcyonium*, sp. fr. | At beginning — Wind W., force 2; weather, very hazy; sea, easterly swell; tide, 5 hours ebb; barometer, 29·78; transparency, 3½ fathoms. At finish—Wind W., force 1; weather, as before; sea, slight; tide, ¾ hours flood; barometer, 29·78; transparency, 3 fathoms. |
| | | | | | ,, | 1 | 14 | ... | ... | ... | ... | | |
| | | | | | Lemon soles, | 1 | 15 | 1 | 14 | 1 | 10 | | |
| | | | | | Common dabs, | 1 | 7 | 3 | 6 | 3 | 5 | | |
| | | | | | Long rough dabs, | 1 | 9 | 1 | 8 | 5 | 7 | | |
| | | | | | ,, ,, | 3 | 6 | ... | ... | ... | ... | | |
| | | | | | Haddocks, | 1 | 22 | 1 | 19 | 1 | 15 | | |
| | | | | | ,, | 3 | 13 | 5 | 11 | 1 | 9 | | |
| | | | | | ,, | 17 | 6 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 3 | 12 | 1 | 11 | 9 | 9 | | |
| | | | | | ,, | 4 | 8 | ... | ... | ... | ... | | |
| | | | | | Angler, | 1 | 18 | ... | ... | ... | ... | | |

TABLE C.—Record of Observations made on Board the 'Garland' during 1891.—I. Firth of Forth—*continued*.

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Temperature. Water. Surface. | Temperature. Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station VIII. 23rd Nov. 10.50 a.m. to 12.45 p.m. | S.W. 48·0 | 46·1 | 48·8 20 fath. | Surface-net.—*Parathemisto*, sp. r.; *Calanus finmarchicus*, r.; *Dias*, sp. r.; *Sagitta*, sp. r.; Infusoria, fr. | Starry ray, | 1 | 10 | ... | ... | ... | ... | *Loligo*, sp., 2 (one 38 inches long, including tentacles; the other small); *Asterias*, sp. r.; *Solaster papposus*, r. | At beginning—Wind S.S.E., force 1; weather, a little hazy; sea, S.E. swell; tide, ½ hour ebb; barometer, 29·81; transparency, 4 fathoms. At finish — Sea easterly swell; tide, 4½ hours ebb; barometer, 29·81; transparency, 6½ fathoms. |
| | | | | | Plaice, | 1 | 18 | 1 | 16 | ... | ... | | |
| | | | | | Common dabs, | 3 | 8 | 1 | 5 | ... | ... | | |
| | | | | | Long rough dabs, | 2 | 7 | 3 | 5 | ... | .. | | |
| | | | | | Haddocks, | 1 | 14 | 2 | 13 | 1 | 12 | | |
| | N.E. 48·0 | 48·4 | 48·8 26 fath. | Bottom-net.—*Thysanoëssa*, sp. f.; *Mysis*, sp. r.; *Calisoma crenata*, f.; *Atylus bispinosus*, fr.; *Parathemisto*, sp. c.; *Calanus finmarchicus*, ab.; *Caligus rapax*, f.; *Sagitta*, sp. c.; *Tomopteris*, sp. r.; young Crustacea, fr. | Whitings, | 1 | 16 | 3 | 10–11 | 1 | 9 | | |
| | | | | | ,, | 2 | 6 | ... | ... | ... | ... | | |
| Station IX. 23rd Nov. 1.40 p.m. to 3.30 p.m. | S.E. 49·0 | 47·8 | 49·0 32 fath. | Surface-net.—*Calanus finmarchicus*, r.; *Sagitta*, sp. r.; Ctenophora, r.; 3 young *Motella mustela*. | Grey skate, | 1 | 15 | ... | ... | ... | ... | *Loligo*, sp. (juv.), f.; *Nephrops norvegicus*, fr. | At beginning—Wind W.S.W., force 2; weather, moderately clear; sea, easterly swell; tide, low water; barometer, 29·81; transparency, 6½ fathoms. At finish — Wind S.W., force 3; tide, 1½ hours flood; barometer, 29·81; transparency, 7 fathoms. |
| | | | | | Thornback ray, | 1 | 21 | ... | ... | ... | ... | | |
| | | | | | Plaice, | 1 | 18 | 1 | 16 | ... | ... | | |
| | | | | | Lemon soles, | 1 | 12 | ... | ... | ... | ... | | |
| | N.W. 49·5 | 48·2 | 49·0 27 fath. | Bottom-net. — *Calisoma crenata*, fr.; *Atylus bispinosus*, fr.; *Parathemisto*, sp. fr.; *Calanus finmarchicus*, c.; *Caligus rapax*, f.; *Sagitta*, sp. c.; *Tomopteris*, sp. fr.; young fish, v.r. | Common dabs, | 2 | 9 | 2 | 7 | 8 | 6 | | |
| | | | | | ,, ,, | 9 | 5 | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 2 | 8 | 22 | 7 | 28 | 5-6 | | |
| | | | | | ,, ,, | 1 | 3 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, | 2 | 5½ | ... | ... | ... | ... | | |
| | | | | | Angler, | 1 | 29 | ... | ... | ... | ... | | |
| Station I. 17th Dec. 1.5 p.m. to 3.15 p.m. | E. 38·0 | 7·4 | 7·5 16 fath. | | Thornback ray, | 1 | 20 | 1 | 14 | 1 | 12 | | At beginning — Wind S.W., force 2; weather, fog; sea, strong S.E. swell; |
| | | | | | ,, ,, | 1 | 9 | ... | ... | ... | ... | | |
| | | | | | Plaice, | 3 | 15 | 7 | 14 | 4 | 12 | | |
| | | | | | Lemon soles, | 2 | 13 | 14 | 12 | 6 | 10 | | |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1891.—I. FIRTH OF FORTH—*continued.*

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Temperature. Water. Surface. | Temperature. Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION I. 17th Dec. 1.5 p.m. to 3.15 p.m. —*continued.* | W. 40·0 | 6·8 | 7·0 12 fath. | | Lemon soles . | 6 | 8 | 4 | 6 | ... | ... | | tide, about 3½ hours flood; barometer, 30·33; transparency, 3 fathoms. At finish—Wind W.; weather, hazy; sea, strong S.E. swell; tide, 5½ hours flood; barometer, 30·32; transparency, 2 fathoms. |
| | | | | | Common dabs, . | 1 | 11 | 2 | 10 | 2 | 9 | | |
| | | | | | „ „ . | 19 | 8 | 12 | 5 | ... | ... | | |
| | | | | | Long rough dabs, | 2 | 10 | 5 | 9 | 24 | 7 | | |
| | | | | | „ „ | 14 | 6 | ... | ... | ... | ... | | |
| | | | | | Haddocks, . . | 4 | 14 | 7 | 13 | 4 | 12 | | |
| | | | | | Cod, . . . | 1 | 27 | 2 | 24 | 1 | 19 | | |
| | | | | | „ . . . | 1 | 18 | 1 | 17 | ... | ... | | |
| | | | | | Whitings, . . | 1 | 14 | 2 | 13 | 12 | 12 | | |
| | | | | | „ . . | 20 | 9 | 7 | 5 | ... | ... | | |
| | | | | | Brassie, . . | 1 | 7 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, . | 1 | 5 | ... | ... | ... | ... | | |
| | | | | | Anglers, . . | 1 | 21 | 1 | 14 | ... | ... | | |
| | | | | | Pogge, . . | 1 | 5 | ... | ... | ... | ... | | |
| | | | | | Cat-fish, . . | 1 | 36 | 1 | 34 | 1 | 28 | | |
| STATION II. 17th Dec. 10.45 a.m. to 12.30 p.m. | E. 40·0 | 6·1 | 7·4 12 fath. | | Starry ray, . | 1 | 10 | ... | ... | ... | ... | | At beginning—Wind S., force 1; weather, hazy; sea, strong S.E. swell; tide, nearly ¼ hour flood; barometer, 30·33 transparency, 2¼ fathoms. At finish — Wind N.W., force 1; weather, fog; sea, strong S.E. swell; tide, nearly ½ hour flood; barometer, 30·33; transparency, 3 fathoms. |
| | | | | | Thornback ray, . | 1 | 13 | ... | ... | ... | ... | | |
| | | | | | Plaice, . . | 1 | 15 | 7 | 14 | 6 | 12 | | |
| | | | | | „ . . | 2 | 10 | ... | ... | ... | ... | | |
| | | | | | Common dabs, . | 1 | 10 | 2 | 8 | 5 | 7 | | |
| | W. 39·0 | 5·8 | 7·0 12 fath. | | „ „ . | 5 | 6 | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 1 | 12 | 1 | 11 | 7 | 9 | | |
| | | | | | „ „ | 12 | 6 | ... | ... | ... | ... | | |
| | | | | | Haddocks, . . | 4 | 12 | 21 | 11 | 8 | 10 | | |
| | | | | | „ . . | 26 | 6 | ... | ... | ... | ... | | |
| | | | | | Cod, . . . | 1 | 15 | ... | ... | ... | ... | | |
| | | | | | Whitings, . . | 16 | 10 | 11 | 8 | 6 | 7 | | |
| | | | | | „ . . | 6 | 5 | 1 | 4 | ... | ... | | |
| | | | | | Angler, . . | 1 | 55 | ... | ... | ... | ... | | |

TABLE C.—Record of Observations made on Board the 'Garland' during 1891.—I. Firth of Forth—*continued*.

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Water. Surface. | Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station III.<br>24th Dec.<br>10.20 a.m. to 12.10 p.m. | W. 39·0 | 6·1c | 7·1c<br>9<br>fath. | Surface-net. — *Parathemisto*, sp. c.; *Calanus finmarchicus*, f.<br>Bottom-net. — *Boreophausia*, sp. fr.; *Parathemisto*, sp. c.; *Hyperia*, sp. r.; *Calanus finmarchicus*, c.; *Sagitta*, sp. c.; *Caligus*, sp. r. | Thornback ray, | 2 | 18 | 1 | 14 | ... | ... | *Pecten opercularis*, f.; *Loligo vulgaris*, r.; *Echinus esculentus*, f.; *Solaster papposa*, f.; *Solaster endeca*, f.; *Asterias*, sp. f.; *Ophiothrix rosula*, f.; *Actinoloba dianthus*, fr. | At beginning — Wind W., force 5; weather, light fog; sea, moderate; tide, 1¼ hours ebb; barometer, 30·14; transparency, 2¼ fathoms.<br>At finish—Wind, weather and sea as before; tide, 3 hours ebb; barometer, 30·13; transparency, 3 fathoms. |
| | | | | | Lemon soles, | 1 | 15 | 1 | 14 | 3 | 11-12 | | |
| | | | | | " " | 1 | 10 | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 1 | 10 | 1 | 9 | 7 | 8 | | |
| | | | | | " " | 23 | 5–6 | ... | ... | ... | ... | | |
| | E. 39·0 | 6·5c | 7·0c<br>11<br>fath. | | Long rough dabs, | 3 | 9 | 2 | 8 | 9 | 7 | | |
| | | | | | " " | 7 | 5 | ... | ... | ... | ... | | |
| | | | | | Haddocks, | 1 | 13 | 2 | 12 | 1 | 10 | | |
| | | | | | " | 18 | 6 | ... | ... | ... | ... | | |
| | | | | | Cod, | 1 | 41 | 3 | 16 | 1 | 15 | | |
| | | | | | " | 1 | 11 | ... | ... | ... | ... | | |
| | | | | | Ling, | 1 | 21 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 3 | 13½ | 22 | 11½ | 16 | 9 | | |
| | | | | | " | 4 | 8 | ... | ... | ... | ... | | |
| | | | | | Brassie, | 2 | 7 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, | 1 | 8 | 1 | 4 | ... | ... | | |
| | | | | | Anglers, | 1 | 26 | 1 | 17 | ... | ... | | |
| Station IV.<br>18th Dec.<br>10.50 a.m. to 2.10 p.m. | E. 41·0 | 6·5 | 6·6<br>8<br>fath. | | Plaice, | 2 | 16 | 3 | 15 | 13 | 14 | | At beginning — Wind S.W., force 2; weather, hazy; sea, slight E. swell; tide, nearly 1 hour flood; barometer, 30·36; transparency, 2 fathoms.<br>At finish—Wind S., force 2; weather, dull and hazy; sea, |
| | | | | | " | 8 | 13 | 2 | 11 | ... | ... | | |
| | | | | | Lemon sole, | 1 | 11 | 3 | 10 | 4 | 9 | | |
| | | | | | " " | 4 | 8 | 3 | 6 | ... | ... | | |
| | | | | | Common dabs, | 1 | 13 | 4 | 10 | 11 | 9 | | |
| | W. 43·0 | 6·3 | 6·5<br>6<br>fath. | | " " | 41 | 8 | 49 | 7 | 25 | 5 | | |
| | | | | | " " | 4 | 4 | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 4 | 10 | 11 | 9 | 22 | 8 | | |
| | | | | | " " | 8 | 6 | 3 | 5 | ... | ... | | |
| | | | | | Haddock, | 1 | 6 | ... | ... | ... | ... | | |
| | | | | | Cod, | 1 | 30 | 1 | 23 | 1 | 22 | | |

TABLE C.—Record of Observations made on Board 'the Garland' during 1891.—I. Firth of Forth—*continued.*

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Water. Surface. | Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station IV. 18th Dec. 10.50 a.m. to 2.10 p.m. —*continued.* | | | | | Cod, . . . | 2 | 20 | 4 | 16 | 2 | 13 | | smooth; tide, nearly ¾ flood; barometer, 30·34; transparency, 2¾ fathoms. |
| | | | | | ,, . . . | 7 | 12 | 1 | 7 | ... | ... | | |
| | | | | | Whitings, . . | 2 | 13 | 37 | 12 | 37 | 9 | | |
| | | | | | ,, . . | 45 | 8 | 23 | 6 | 6 | 5 | | |
| | | | | | Anglers, . . | 1 | 18 | 2 | 16 | 3 | 13 | | |
| Station V. 23rd Dec. 10.45 a.m to 1.10 p.m. | W. 42·5 | 7·4c | 7·6c 29 fath. | Surface-net.—*Tauria*, sp. r.; *Parathemisto*, sp. f.; *Calanus finmarchicus*, f.; *Sagitta*, sp. f. | Thornback ray, . | 1 | 11 | ... | ... | .. | ... | *Octopus vulgaris*, 1; *Loligo vulgaris*, 2; *Nephrops norvegicus*, r.; *Asterias*, sp. r. | At beginning — Wind W., force 5; weather, hazy; sea, slight; tide, 2¾ hours ebb; barometer, 30·33; transparency, 5 fathoms. |
| | | | | | Plaice, . . | 3 | 16 | 1 | 14 | 1 | 13 | | |
| | | | | | Common dabs, . | 1 | 10 | 1 | 8 | 3 | 7 | | |
| | | | | | ,, ,, . | 3 | 6 | ... | ... | ... | ... | | |
| | E. 43·0 | 7·4c | 7·7c 23 fath. | Bottom-net.—*Parathemisto*, sp. ab.; *Atylus bispinosus*, fr.; *Calisoma crenata*, f.; *Calanus finmarchicus*, c.; *Sagitta*, sp. ab. | Long rough dabs, | 3 | 9 | 11 | 7½ | 11 | 5 | | At finish—Wind W.S.W., force 4; weather and sea as before; tide, 5¾ hours ebb; barometer, 30·33; transparency, 6 fathoms. |
| | | | | | Haddocks, . . | 3 | 6 | ... | ... | ... | ... | | |
| | | | | | Cod, . . . | 1 | 22 | ... | ... | ... | ... | | |
| | | | | | Whitings, . . | 2 | 17 | 1 | 15 | 1 | 11 | | |
| | | | | | ,, . . | 2 | 10 | ... | ... | ... | ... | | |
| | | | | | Hake, . . | 1 | 17 | ... | ... | ... | ... | | |
| | | | | | Anglers, . . | 1 | 25 | 1 | 19 | ... | ... | | |
| | | | | | Dragonet, . . | 1 | 6 | ... | ... | ... | ... | | |
| Station VI. 33rd Dec. 2.30 p.m. to 3.20 p.m. | E. 41·0 | 7·1c | 7·2c 12½ fath. | Surface-net.—*Parathemisto*, sp. f.; *Sagitta*, sp. r.; small Ctenophores, f. | Plaice, . . | 3 | 18½ | 14 | 17 | 33 | 16 | *Octopus vulgaris*, 2; *Echinus esculentus*, several; *Asterias*, sp. fr.; *Ophioglypha albida*, fr. | At beginning — Wind N.W., force 2; weather, fog; sea, slight; tide, low water; barometer, 30·29; transparency, 4½ fathoms. |
| | | | | | ,, . . | 4 | 11 | ... | ... | ... | ... | | |
| | | | | | Lemon soles, . | 2 | 14 | 1 | 13 | 4 | 12 | | |
| | | | | | Common dabs, . | 3 | 10 | 5 | 8 | 5 | 7 | | |
| | | | | | ,, ,, . | 17 | 5–6 | ... | ... | ... | ... | | |
| | W. 40·5 | 7·2c | 7·5c 18½ fath. | Bottom-net.—*Calanus finmarchicus*, fr.; *Sagitta*, sp. c. | Long rough dabs, | 1 | 8 | 2 | 7 | 1 | 6 | | At finish—Wind |
| | | | | | Turbot, . . | 1 | 25 | ... | ... | ... | ... | | |
| | | | | | Brill, . . . | 1 | 25 | 1 | 24 | 1 | 21 | | |

TABLE C.—Record of Observations made on Board the 'Garland' during 1891.—I. Firth of Forth—*continued*.

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Temperature. Water. Surface. | Temperature. Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station VI. 23rd Dec. 2.30 p.m. to 3.20 p.m. —*continued*. | | | | | Haddock, | 1 | 18 | ... | ... | ... | ... | | N.W., force 1; weather and sea as before; tide, 1 hour flood; barometer, 30·28; transparency, 4¼ fathoms. |
| | | | | | Com. gurnards, | 2 | 6 | ... | ... | ... | ... | | |
| | | | | | Cat fish, | 1 | 24 | ... | ... | ... | ... | | |
| | | | | | Dragonet, | 1 | 8 | ... | ... | ... | ... | | |
| Station VII. 21st Dec. 11.0 a.m to 12.45 p.m. | W. 42·0 | 6·2 | 7·0 10 fath. | | Cod, | 1 | 5 | ... | ... | ... | ... | | At beginning—Wind W.S.W., force 4; weather, hazy; sea, smooth; tide, about ¾ ebb; barometer, 30·48; transparency, 2½ fathoms. At finish — Wind W.S.W., force 4; weather, hazy; sea, slight, west; tide, first of flood; barometer, 30·48; transparency, 2¾ fathoms. |
| | | | | | Brassie, | 1 | 7 | ... | ... | ... | ... | | |
| | | | | | Whiting, | 1 | 11 | 1 | 10 | 1 | 9 | | |
| | | | | | ,, | 2 | 8 | 1 | 6 | 1 | 5 | | |
| | E. 43·0 | 6·5 | 7·3 16 fath. | | (Trawl working well.) | | | | | | | | |
| Station VIII. 21st Dec. 1.10 p.m. to 3.10 p.m. | S.W. 43·0 | 6·9 | 7·5 20 fath. | | Plaice, | 1 | 16 | ... | ... | ... | ... | | At beginning—Wind W.S.W., force 4; weather, hazy; sea, moderate, west; tide, nearly 1 hour flood; barometer, 30·48; transparency, 3½ fathoms. At finish — Tide, nearly ½ flood; barometer, 30·47; transparency, 5 fathoms. |
| | | | | | Lemon sole, | 1 | 13 | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 1 | 8 | 1 | 7 | ... | ... | | |
| | | | | | Haddock, | 1 | 13 | ... | ... | ... | ... | | |
| | | | | | Cod, | 1 | 14 | ... | ... | ... | ... | | |
| | N.E. 42·0 | 8·1 | 7·7 27½ fath. | | | | | | | | | | |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1891.—I. FIRTH OF FORTH—*continued.*

| Station, Date, and Time Trawl down. | Temperature. | | | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. | | | | | | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Air. | Water. | | | | | | | | | | | |
| | Dry Bulb. | Surface. | Bottom. | | | No. | Inches | No. | Inches | No. | Inches | | |
| STATION IX. 22nd Dec. 12.20 p.m. to 2.15 p.m. | E. 43·0 | 6·9 | 7·8 32 fath. | | Common dabs, | 1 | 7 | 3 | 6 | 2 | 5 | | At beginning—Wind W.N.W., force 4; weather, very hazy; sea, slight from W.; tide, about 5 hours ebb; barometer, 30·48; transparency, 5½ fathoms. At finish — Tide, about 1 hour flood; barometer, 30·43; transparency, 5½ fathoms. |
| | | | | | Long rough dabs, | 1 | 10 | 1 | 8 | 14 | 7 | | |
| | | | | | " " | 12 | 5 | ... | ... | ... | ... | | |
| | W. 43·0 | 7·0 | 7·9 29 fath. | | Witch sole, | 1 | 8 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 1 | 14 | 1 | 13 | 9 | 12 | | |
| | | | | | " | 4 | 10 | 1 | 9 | ... | ... | | |
| | | | | | Hake, | 1 | 3 | ... | ... | ... | ... | | |
| | | | | | Cat-fish, | 1 | 27 | ... | ... | ... | ... | | |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1891.—II. ST ANDREWS BAY.

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Temperature. Water. Surface. | Temperature. Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION I. 13th Feb. 4.0 p.m. to 6.0 p.m. | E. 39·5<br>W. 40·5 | 5·2<br>5·0 | 5·3 12 fath.<br>5·0 8 fath. | Surface-net.—*Parathemisto oblivia*, ab.; some weed (Herring appear to be living on the *Parathemisto* and Schizopods). Bottom-net.—*Calanus finmarchicus*, f.; *Parathemisto*, sp. fr.; *Stenöthoe marina*, r.; *Atylus bispinosus*, r.; *Boreophausia*, sp. f.; *Mysis spiritus*, r.; *Gastrosaccus spinifer*, r.; *Rossia*, sp. (juv.), r.; *Sagitta*, sp. c.; young herring, f. | Starry ray, | 1 | 11 | ... | ... | ... | ... | Only a very small quantity of weed. | At beginning—Wind S.W., force 4; weather, overcast; sea, slight easterly swell; tide, ; barometer, 30·45; transparency, 3 fathoms. At finish—Wind W., force 3; tide, ; barometer, 30·41. |
| | | | | | Plaice, | 1 | 14½ | 12 | 13 | 5 | 12 | | |
| | | | | | ,, | 3 | 10 | ... | ... | ... | ... | | |
| | | | | | Common dab, | 1 | 11 | ... | ... | ... | ... | | |
| | | | | | Cod, | 2 | 24½ | ... | ... | ... | ... | | |
| | | | | | Whiting, | 1 | 5½ | 2 | 4½ | ... | ... | | |
| | | | | | Sprats, | 4 | 4-4½ | ... | ... | ... | ... | | |
| | | | | | Herrings, | 25 | 7 | ... | ... | ... | ... | | |
| STATION II. 13th Feb. 2.10 p.m. to 3.45 p.m. | W. 40·0<br>E. 39·6 | 5·0<br>5·2 | 5·0 8 fath.<br>5·1 12 fath. | Surface-net. — *Parathemisto oblivia*, c.; *Hyperia*, sp. r.; *Boreophausia*, sp. f. Bottom-net. — *Calanus finmarchicus*, f.; *Parathemisto*, sp. f.; *Sagitta*, sp. c.; young common pipe fish (*Syngnathus*), r. | Starry ray, | 2 | 10 | 1 | 9 | ... | ... | Only a little weed. | At beginning—Wind S.S.W., force 2; weather, overcast; sea, smooth; tide, ; barometer, 30·46; transparency, 3 fathoms. At finish—Wind S.W., force 3; tide, ; barometer, 30·46; transparency, 3 fathoms. |
| | | | | | Sandy ray, | 1 | 4½ | ... | ... | ... | ... | | |
| | | | | | Plaice, | 10 | 13 | 4 | 12 | ... | ... | | |
| | | | | | Lemon sole, | 1 | 13 | ... | ... | ... | ... | | |
| | | | | | Common dab, | 1 | 5 | ... | ... | ... | ... | | |
| | | | | | Cod, | 1 | 32 | 1 | 30 | 1 | 29 | | |
| | | | | | ,, | 1 | 23 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 2 | 4½ | ... | ... | ... | ... | | |
| | | | | | Herrings, | 4 | 7½ | ... | ... | ... | ... | | |
| | | | | | Father-lasher, | 1 | 5 | ... | ... | ... | ... | | |
| STATION III. 13th Feb. 12.12 p.m. to 1.45 p.m. | E. 39·0 | 5·3 | 5·4 11 fath. | Surface-net.—*Parathemisto oblivia*, f.; *Atylus swammerdami*, r.; *Beroë*, sp. r. Bottom-net.—*Calanus finmarchicus*, fr.; *Hyperia*, sp. | Plaice, | 5 | 14 | 4 | 12 | 1 | 9 | *Asterias*, sp. f.; *Portunus holsatus*, 1; a very small | At beginning—Wind E., force 1; weather, overcast; sea, smooth, easterly swell; tide, ; barometer, |
| | | | | | Lemon sole, | 1 | 10 | ... | ... | ... | ... | | |
| | | | | | Common dab, | 2 | 6 | ... | ... | ... | ... | | |
| | | | | | Long rough dab, | 1 | 7 | ... | ... | ... | ... | | |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1891.—II. ST ANDREWS BAY—*continued.*

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Temperature. Water. Surface. | Temperature. Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION III. 13th Feb. 12.12 p.m. to 1.45 p.m. —*continued.* | W. 40·1 | 5·2 | 5·1 11 fath. | r.; *Parathemisto*, sp. f.; *Boreophausia*, sp. f.; *Mysis inermis*, r.; *Gastrosaccus spinifer*, r.; *Macropsis slabberi*, r.; *Crangon allmanni*, f.; *Sagitta*, sp. c.; young pipe fish (*Syngnathus*), f. | Cod, | 5 | 29 | 1 | 27 | 1 | 23 | quantity of weed. | 30·48; transparency, 3 fathoms. At finish—Wind S., force 1; weather, overcast; tide, ; barometer, 30·46; transparency, 3 fathoms. |
| | | | | | Whitings, | 1 | 7 | 1 | 4 | ... | ... | | |
| | | | | | Cat-fish, | 1 | 33 | ... | ... | ... | ... | | |
| | | | | | Herrings, | 1 | 7 | 1 | 6 | 2 | 3½ | | |
| | | | | | ,, | 1 | 2½ | ... | ... | ... | ... | | |
| | | | | | Sprats, | 2 | 5 | .. | ... | ... | ... | | |
| | | | | | Father-lasher, | 1 | 5½ | ... | ... | ... | ... | | |
| STATION IV. 13th Feb. 8.35 a.m. to 10.0 a.m. | E. 34·0 | 5·5 | 5·1 12 fath. | Surface net—*Calanus finmarchicus*, fr.; *Parathemisto oblivia*, c.; *Eurydice pulchra*, r.; *Sagitta*, sp. r. | Grey skate, | 1 | 16 | 2 | 15 | ... | ... | Only a little weed and 1 or 2 *Asterias*, sp. | At beginning—Wind N.E., force 4; weather, cloudy; sea, slight easterly swell; tide, ; barometer, 30·40; transparency, 1½ fathoms. At finish—Wind N.E., force 3; weather, cloudy; sea, as before; tide, ; barometer, 30·47; transparency, 3 fathoms. |
| | | | | | Starry ray, | 1 | 11 | 1 | 10 | 1 | 9 | | |
| | | | | | Plaice, | 9 | 13½ | 7 | 11 | 3 | 10½ | | |
| | | | | | Common dabs, | 1 | 7 | 1 | 6 | 1 | 5 | | |
| | | | | | Flounders, | 1 | 16 | 1 | 10 | 1 | 7 | | |
| | W. 34·5 | 5·0 | fath. | Bottom-net—*calanus*, sp. f.; *Parathemisto*, sp. f.; *Atylus swammerdami*, r.; *Bathyporeia*, sp. r.; *Ampelisca*, sp. r.; *Stenothöe marina*, r.; *Mysis inermis*, f.; *Mysis spiritus*, r.; *Mysis flexuosus*, r.; *Macropsis slabberi*, f.; *Gastrosaccus spinifer*, fr.; *Diastylis rathkii*, r.; *Pseudocuma cercaria*, r.; *Boreophausia*, sp. f.; *Idotea emarginata*, r.; *Crangon allmanni*, r.; young herring, f.; young pipe fish (*Syngnathus*), r.; small Ctenophora, f. | Turbot, | 1 | 7 | ... | ... | ... | ... | | |
| | | | | | Cod, | 2 | 30 | 1 | 26 | ... | ... | | |
| | | | | | Whitings, | 1 | 6 | 2 | 5 | ... | ... | | |
| | | | | | Herrings, | 5 | 8 | 9 | 2–2½ | ... | ... | | |
| | | | | | Father-lasher, | 1 | 6 | ... | ... | ... | ... | | |

TABLE C.—Record of Observations made on Board the 'Garland' during 1891.—II. St Andrews Bay—*continued.*

| Station, Date, and Time Trawl down. | Temperature. | | | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. | | | | | | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Air. | Water. | | | | | | | | | | | |
| | Dry Bulb. | Surface. | Bottom. | | | No. | Inches | No. | Inches | No. | Inches | | |
| Station V. 12th Feb. 4.25 p.m. to 6.25 p.m. | S. 42·0 | 5·7 | 5·4 16 fath. | Surface-net.—*Calanus finmarchicus*, ab.; *Parathemisto oblivia*, c.; a quantity of weed. | Starry ray, | 1 | 12 | 1 | 8 | ... | ... | | At beginning—Wind N.N.W., force 3; weather, clear; sea, S.E. swell, ; barometer, 30·19; transparency, 3 fathoms. At finish — Wind W.N.W., force 4; weather, clear; sea, as before; tide, ; barometer, 30·19; transparency, too dark. |
| | | | | | Plaice, | 1 | 14 | 1 | 13 | ... | ... | | |
| | | | | | Lemon sole, | 1 | 14 | 1 | 11 | ... | ... | | |
| | | | | | Common dab, | 1 | 12 | 2 | 5 | ... | ... | | |
| | N. 40·0 | 5·3 | 5·4 15 fath. | Bottom-net.—*Parathemisto*, sp. f.; *Tryphosa nana*, f.; *Phoxus denticulatus*, r.; *Calisoma crenata*, r.; *Monoculodes longimanus*, r.; *Boreophausia raschii*, fr.; *Mysis inermis*, f.; *Mysis ornatus*, f.; *Gastrosaccus spinifer*, f.; *Pseudocuma cercaria*, r.; *Eudorella truncatula*, r.; *Pandalus brevicornis*, r.; *Crangon allmanni*, fr.; *Erythrops goesii*, f.; *Sagitta*, sp. c. | Long rough dabs, | 1 | 7 | 1 | 6 | 1 | 5 | | |
| | | | | | Haddocks, | 1 | 18 | 1 | 17 | ... | ... | | |
| | | | | | Cod, | 26 | 3 | 22 | 2 | 1 | 11 | | |
| | | | | | Whitings, | 1 | 7 | 2 | 4 | ... | ... | | |
| | | | | | Herrings, | 36 | 7 | ... | ... | ... | ... | | |
| | | | | | Sprats, | 2 | 4½ | ... | ... | ... | ... | | |
| Station I. 3rd July 1.15 p.m. to 3.40 p.m. | W. 56·5 | 12·5 | 51·0 6½ fath. | Surface-net.—*Tauria medusarum*, f.; *Parathemisto*, sp. r.; *Calanus finmarchicus*, f.; *Temora longicornis*, fr.; *Anomalocera patersonni*, fr.; small Ctenophora, fr.; fish ova, c.; young fish (*Cyclopterus*, &c.), r. | Plaice, | 2 | 15 | 14 | 12 | 6 | 10½ | *Corystes casivelannus*, r.; *Eupagurus bernhardus*, f.; *Aurelia*, sp. fr.; some weed. | At beginning—Wind N.W., force 3; weather, dull, showery; sea, slight; tide, first ¼ ebb; barometer, 29·68; transparency, 6¼ fathoms. At finish — Wind variable, force 1-2; tide, about 4 hours ebb; barometer, 29·71; transparency, 6 fathoms. |
| | | | | | " | 106 | 8½ | 76 | 6 | ... | ... | | |
| | | | | | Common dabs, | 2 | 12 | 15 | 10½ | 8 | 8½ | | |
| | | | | | " " | 43 | 7 | 14 | 6 | 2 | 5 | | |
| | | | | | Long rough dabs, | 2 | 11 | ... | ... | ... | ... | | |
| | E. 57·5 | 11·8 | | | Com. gurnards, | 2 | 14 | 5 | 12 | 10 | 10 | | |
| | | | 49·8 11½ fath. | Bottom-net.—*Tauria*, sp. r.; *Calanus finmarchicus*, f.; *Evadne*, sp. f.; small Ctenophora, c. | " " | 14 | 6½ | ... | ... | ... | ... | | |

TABLE C.—Record of Observations made on Board the 'Garland' during 1891.—II. St Andrews Bay—*continued.*

| Station, Date, and Time Trawl down. | Temperature. | | | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. | | | | | | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Air. | Water. | | | | | | | | | | | |
| | Dry Bulb. | Surface. | Bottom. | | | No. | Inches | No. | Inches | No. | Inches | | |
| Station II. 3rd July 10.12 a.m. to 12 noon. | E. 56·2 | 12·2 | 50·9 12 fath. | Surface-net. — *Tauria medusarum*, r.; *Calanus finmarchicus*, f.; *Temora longicornis*, fr.; *Dias*, sp. f.; *Anomalocera paterson-ni*, f.; *Evadne*, sp. c. | Plaice, | 1 | 15 | 17 | 12½ | 3 | 11 | *Eupagurus bernhardus*, f.; *Aurelia*, sp. several; a quantity of weed. | At beginning—Wind S.W., force 2; weather, dull, showery; sea, slight; tide, about ¾ flood; barometer, 29·64; transparency, 7 fathoms. |
| | | | | | ,, | 57 | 7–8½ | 18 | 5½ | ... | ... | | |
| | | | | | Common dabs, | 3 | 9½ | 17 | 8 | 6 | 6 | | |
| | | | | | ,, ,, | 2 | 4 | ... | ... | ... | ... | | |
| | | | | | Flounder, | 1 | 6½ | ... | ... | ... | ... | | |
| | | | | | Whitings, | 3 | 10 | ... | ... | ... | ... | | |
| | W. 58·0 | 12·8 | 50·0 9 fath. | Bottom-net. — *Tauria*, sp. f.; *Evadne*, sp. f.; small Ctenophora, ab. | Com. gurnards, | 3 | 12 | 4 | 10½ | 3 | 8 | | At finish — Wind N.W., force 4; tide, high water; barometer, 29·66; transparency, 6 fathoms. |
| | | | | | ,, ,, | 5 | 7 | ... | ... | ... | ... | | |
| | | | | | Angler, | 1 | 16½ | ... | ... | ... | ... | | |
| Station III. 3rd July 7.25 a.m. to 9.35 a.m. | W. 56·0 | 12·5 | 50·5 7 fath. | Surface-net. — *Tauria medusarum*, r.; *Calanus finmarchicus*, f.; *Temora longicornis*, fr.; *Dias*, sp. f.; *Anomalocera paterson-ni*, f.; *Evadne*, sp. c. | Grey skate, | 1 | 18 | ... | ... | ... | ... | *Portunus holsatus*, r.; *Asterias*, sp. r.; a quantity of weed. | At beginning—Wind S.W., force 4; weather, dull, showery; sea, slight; tide, first ¼ flood; barometer, 29·63; transparency, 5¼ fathoms. |
| | | | | | Plaice, | 2 | 16½ | 19 | 13 | 33 | 8–10 | | |
| | | | | | ,, | 51 | 6½–7½ | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 3 | 11½ | 1 | 9½ | 19 | 7–8 | | |
| | | | | | Flounders, | 2 | 9 | 1 | 7 | ... | ... | | |
| | | | | | Long rough dabs, | 2 | 9 | ... | ... | ... | ... | | |
| | E. 57·8 | 12·8 | 50·1 13 fath. | Bottom-net. — *Tauria*, sp. f.; *Evadne*, sp. f.; small Ctenophora, ab. | Haddock, | 1 | 12 | ... | ... | ... | ... | | At finish — Wind S.W., force 2; tide, about 4 hours flood; barometer, 29·64; transparency, 5¼ fathoms. |
| | | | | | Whiting, | 1 | 11½ | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, | 1 | 15 | 3 | 10½ | ... | ... | | |
| Station IV. 2nd July 4.5 p.m. to 6.45 p.m. | E. 61·0 | 12·6 | 53·0 8 fath. | Surface-net.—*Parathemisto*, sp. r.; *Gammarus*, sp. r.; *Calanus finmarchicus*, fr.; *Temora longicornis*, f.; *Dias*, sp. c.; *Evadne*, sp. fr.; *Podon*, sp. fr. | Thornback ray, | 2 | 21 | 1 | 16 | ... | ... | A considerable quantity of weed in the trawl net, but no invertebrates. | At beginning—Wind S.W., force 4; weather, cloudy, fine; sea, slight; tide, about ¾ ebb; barometer, 29·66; transparency, 5 fathoms. |
| | | | | | Plaice, | 5 | 15½ | 14 | 12 | 18 | 10 | | |
| | | | | | ,, | 22 | 9 | 24 | 7½ | 42 | 6½ | | |
| | | | | | Common dabs, | 1 | 13 | 2 | 10 | 6 | 8½ | | |
| | | | | | ,, ,, | 29 | 6–7½ | ... | ... | ... | ... | | |
| | | | | | Flounders, | 1 | 9 | ... | ... | ... | ... | | |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1891.—II. ST. ANDREWS BAY—*continued.*

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Water. Surface. | Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c., brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION IV. 2nd July 4.5 p.m. to 6.45 p.m. —*continued.* | W. 60·0 | 12·7 | 53·3 5 fath. | Bottom-net.—*Hyperia*, sp. r.; *Calanus*, sp. f.; *Temora*, sp. f.; *Evadne*, sp. fr.; *Podon*, sp. c.; small Ctenophora, ab. | Com. gurnards, | 1 | 14 | 8 | 12½ | 7 | 11 | | At finish — Wind S.W.; force 5; tide, first ¼ flood; barometer, 29·64; transparency, 5 fathoms. |
| | | | | | ,, ,, | 6 | 7½-9 | ... | ... | ... | ... | | |
| | | | | | Angler, | 1 | 8½ | ... | ... | ... | ... | | |
| | | | | | Father-lasher, | 1 | 7½ | ... | ... | ... | ... | | |
| STATION V. 2nd July 1.25 p.m. to 3.30 p.m. | S. 60·5 | 13·1 | 50·5 15 fath. | Surface-net.—*Hyperia*, sp. r.; *Calanus finmarchicus*, c.; *Temora longicornis*, fr.; *Dias*, sp. f.; *Centropages*, sp. f.; *Anomalocera patersonni*, f.; *Evadne*, sp. ab.; *Podon*, sp. f.; fish ova, fr. | Plaice, | 2 | 14½ | 18 | 13 | 19 | 11½ | A few half-grown *Loligo*, sp. only. | At beginning — Wind E.; force 1; weather, cloudy, fine; sea, slight; tide, first ¼ ebb; barometer, 29·67; transparency, 6½ fathoms. |
| | | | | | ,, | 48 | 7-9 | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 5 | 7 | 27 | 6 | 7 | 5 | | |
| | | | | | ,, ,, | 5 | 4 | ... | ... | ... | ... | | |
| | | | | | Flounder, | 1 | 7½ | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 1 | 8½ | 2 | 7½ | 1 | 6 | | |
| | N. 60·7 | 12·9 | 50·5 13 fath. | Bottom-net.—*Parathemisto*, sp. f.; *Tauria*, sp. r.; *Calanus*, sp. f.; *Temora*, sp. f.; *Dias*, sp. f.; *Centropages*, sp. r.; *Alteutha depressa*, r.; *Sagitta*, sp. fr.; small Ctenophora, fr.; young *Natica*, fr.; young star fish, fr.; larval decapod Crustacea, fr. | Haddocks, | 1 | 11 | 2 | 8 | ... | ... | | At finish—Wind S.S.E., force 1; tide, fully 4 hours ebb; barometer, 29·67; transparency, 6 fathoms. |
| | | | | | Whitings, | 5 | 11½ | 10 | 10½ | 13 | 9 | | |
| | | | | | ,, | 1 | 7 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, | 3 | 12 | 4 | 10 | 4 | 6½-7 | | |
| STATION I. 22nd July 6.5 a.m. to 7.55 a.m. | W. 57·0 | 57·5 | 54·5 6 fath. | Surface-net.—*Calanus finmarchicus*, f.; *Dias longiremis*, f.; *Temora longicornis*, fr.; *Centropages*, sp. f.; *Anomalocera patersonni*, fr.; *Evadne*, sp. fr.; larval Crustacea c.; fish ova, f. | Thornback ray, | 3 | 20 | ... | ... | ... | ... | A few *Asterias*, sp. and *Aurelia*, sp. only. | At beginning—Wind N.W., force 1; weather, cloudy; sea, slight; tide, about 3 hours ebb; barometer, 29·73; transparency, 4½ fathoms. |
| | | | | | Plaice, | 1 | 16 | 4 | 13 | 8 | 11 | | |
| | | | | | ,, | 46 | 8 | 27 | 6 | ... | ... | | |
| | | | | | Common dabs, | 1 | 12 | 1 | 10 | 15 | 9 | | |
| | | | | | ,, ,, | 21 | 7 | 2 | 5½ | ... | ... | | |
| | | | | | Com. gurnards, | 10 | 14 | 7 | 10 | 2 | 6 | | |
| | E. 57·0 | 58·0 | 52·4 11½ fath. | Bottom-net.—*Cuma*, sp. f.; *Tauria*, sp. r.; *Atylus bispinosus*, r.; *Stenothoe*, sp. r.; | | | | | | | | | At finish — Wind N.N.W., force 3; tide, about 5 hours ebb; |

(The six No./Inches columns are grouped under "Number and Size of Fish.")

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1891.—II. ST ANDREWS BAY—*continued.*

| Station, Date, and Time Trawl down. | Temperature. | | | Pelagic Fauna, Spawn and young Fish. | Description of Take. | Number and Size of Fish. | | | | | | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Air. | Water. | | | | | | | | | | | |
| | Dry Bulb. | Surface. | Bottom. | | | No. | Inches | No. | Inches | No. | Inches | | |
| STATION I. 22nd July 6.5 a.m. to 7.55 a.m.—*continued.* | | | | *Calanus*, sp. f.; *Dias*, sp. fr.; *Temora*, sp. fr.; *Caligus*, sp. r.; larval Crustacea, fr.; post-larval fish, f. | | | | | | | | | barometer, 29·75; transparency, 5 fathoms. |
| STATION II. 22nd July 3.15 p.m. to 5.0 p.m. | E. 59·0 | 55·2 | 52·6 13 fath. | Surface-net.—*Stenothöe*, sp. r.; *Temora longicornis*, f.; small Ctenophora, fr.; larval *Balani* and other Crustacea, fr.; fish ova, r.; (very little in net). | Plaice, | 1 | 15½ | 6 | 13 | 1 | 11 | Only a few young *Loligo* and several large Medusidæ. | At beginning—Wind variable, light; weather, dull; sea, smooth; tide, first ¼ ebb; barometer, 29·74; transparency, 4 fathoms. |
| | | | | | ,, | 25 | 8 | 5 | 6 | ... | ... | | |
| | | | | | Common dabs, | 1 | 9 | 5 | 7 | 3 | 6 | | |
| | | | | | Com. gurnards, | 1 | 13 | 1 | 12 | 1 | 11 | | |
| | W. 59·0 | 57·8 | 56·0 7 fath. | Bottom-net.—(Damaged, contents lost. | | | | | | | | | At finish — Wind W.N.W., force 2; tide, nearly ¼ ebb; barometer, 29·75; transparency, 4 fathoms. |
| STATION III. 22nd July 1.0 p.m. to 2.50 p.m. | W. 64·0 | 58·8 | 56·0 7 fath. | Surface-net.—*Eurydice pulchra*, r.; *Dias longiremis*, fr.; *Temora longicornis*, f.; *Anomalocera patersonni*, f.; *Evadne*, sp. fr.; small Ctenophora, f.; larval Crustacea, f.; fish ova, r. | Thornback ray, | 1 | 20 | ... | ... | ... | ... | Several large Medusidæ and some weed (very little). | At beginning—Wind calm; force 0; weather, dull; sea, smooth; tide, about ¾ flood; barometer, 29·74; transparency, 5 fathoms. |
| | | | | | Plaice, | 7 | 13 | 1 | 12 | 27 | 9 | | |
| | | | | | ,, | 22 | 6 | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 1 | 11 | 5 | 9½ | 11 | 7½ | | |
| | | | | | ,, ,, | 1 | 4 | ... | ... | ... | ... | | |
| | | | | | Haddock, | 1 | 11½ | ... | ... | ... | ... | | |
| | E. 59·0 | 55·1 | 52·0 13½ fath. | Bottom-net.—*Stenothöe*, sp. r.; *Temora longicornis*, f.; larval Ctenophora, fr.; larval *Balani* and other Crustacea, fr.; larval Echinoderms, fr.; post-larval fish, f. | Com. gurnards, | 1 | 11 | 3 | 10 | 1 | 9 | | At finish — Wind W.N.W., force 1; tide, high water; transparency, 3½ fathoms. |

TABLE C.—Record of Observations made on Board the 'Garland' during 1891.—II. St Andrews Bay—*continued.*

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Water. Surface. | Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station IV. 22nd July 10.20 a.m. to 12.45 p.m. | E. 56·0 | 56·4 | 53·2 7 fath. | Surface-net. — *Atylus bispinosus*, r.; *Dias longiremis*, f.; *Evadne*, sp. f.; larval Crustacea, c.; fish ova, r. Bottom-net. — Small Ctenophora, c.; larval *Balani* and other Crustacea, fr.; young starfish, fr.; a quantity of fine sticky mud. | Plaice, | 3 | 11 | 1 | 10 | 8 | 9 | Only a few large Medusids. | At beginning—Wind W.S.W., force 2; weather, dull, rain; sea, smooth, E. swell; tide, first ¼ flood; barometer, 29·74; transparency, 3 fathoms. At finish — Wind calm, force 0; tide, fully 4 hours flood; transparency, 5½ fathoms. |
| | | | | | ,, | 8 | 7 | 3 | 5½ | ... | ... | | |
| | | | | | Common dabs, | 12 | 9 | 29 | 8 | 7 | 6 | | |
| | | | | | Flounders, | 2 | 16 | 1 | 9 | 1 | 8 | | |
| | | | | | Com. gurnards, | 24 | 13 | 12 | 11 | 9 | 6½ | | |
| Station V. 22nd July 8.8 a.m to 9.50 a.m. | S. 56·8 | 56·2 | 52·5 12 fath. | Surface-net. — *Atylus bispinosus*, several; *Dias longiremis*, f.; *Temora longicornis*, f.; *Anomalocera patersonni*, f.; *Evadne*, sp. f.; small Ctenophora, f.; larval Crustacea, ab.; fish ova, f. Bottom-net.—*Temora*, sp. f.; small Ctenophora, fr.; larval *Balani* and other Crustacea, fr.; young *Peachia*, sp. r.; young sandstars, fr.; post-larval fish, f. | Plaice, | 1 | 23 | 3 | 14 | 10 | 12 | A few young *Loligo vulgaris* and *Asterias*, sp., 1; *Aphrodite aculeata*; several Aurelia and one or two Zoophytes. | At beginning—Wind N.N.W., force 3; weather, dull; sea, slight; tide, last ¼ ebb; barometer, 29·74; transparency, 5 fathoms. At finish — Wind W.N.W., force 1; tide, first ¼ flood; transparency, 4 fathoms. |
| | | | | | ,, | 11 | 9 | 12 | 7 | ... | ... | | |
| | | | | | Common dabs, | 1 | 8½ | 4 | 7½ | 9 | 6 | | |
| | | | | | ,, ,, | 1 | 4½ | ... | ... | ... | ... | | |
| | | | | | Flounder, | 1 | 8 | ... | ... | ... | ... | | |
| | | | | | Long rough dab, | 1 | 12 | ... | ... | ... | ... | | |
| | N. 56·0 | 55·0 | 52·0 13 fath. | | Whitings, | 1 | 11 | 2 | 9½ | 1 | 8 | | |
| | | | | | Com. gurnards, | 1 | 15 | 10 | 13 | 5 | 9 | | |
| Station I. 25th August 10.35 a.m to 12.45 p.m. | W. 60·0 | 55·9 | 55·1 7 fath. | Surface-net. — *Dexamina*, sp. r.; *Calanus finmarchicus* f.; *Temora longicornis*, f. (very little in net). Bottom-net.—*Gastrosaccus spinifer*, f.; *Calanus finmar-* | Plaice, | 5 | 12 | 11 | 10 | 24 | 7½ | | At beginning—Wind W., force 4; weather, cloudy; sea, slight; tide, fully ¾ ebb; barometer, 29·29; transparency, 3 fathoms. At finish—Wind W., |
| | | | | | Common dabs, | 2 | 13 | 7 | 11 | 21 | 9 | | |
| | | | | | ,, ,, | 39 | 6½ | 11 | 5 | ... | ... | | |
| | | | | | Com. gurnards, | 15 | 14 | 16 | 12 | 3 | 7 | | |
| | | | | | ,, ,, | 1 | 5 | ... | ... | ... | ... | | |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1891.—II. ST ANDREWS BAY—*continued.*

| Station, Date, and Time Trawl down. | Temperature. | | | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. | | | | | | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Air. | Water. | | | | | | | | | | | |
| | Dry Bulb. | Surface. | Bottom. | | | No. | Inches | No. | Inches | No. | Inches | | |
| STATION I. 25th August 10.35 a.m. to 12.45 p.m. —*continued.* | E. 60·0 | 55·4 | 54·0 12 faths. | *chicus*, f.; *Temora longicornis*, f.; *Caligus rapax*, f.; *Sagitta*, sp. f.; larval and young Gastropods and Lamellibranch Mollusca, fr.; larval Crustacea, fr.; young fish (*Syngnathus*, *Cyclopterus*, plaice), r. | | | | | | | | | force 6; tide, first of flood; barometer, 29·30; transparency, 4 fathoms. |
| STATION II. 25th August 8.30 a.m. to 10.20 a.m. | E. 54·5 | 55·4 | 54·6 13 fath. | Surface-net. — *Dias longiremis*, f.; *Temora longicornis*, f.; *Centropages*, sp. f.; larval Crustacea, f. | Plaice,<br>″<br>Common dabs,<br>Com. gurnards, | 1<br>2<br>1<br>2 | 16<br>7<br>15<br>14 | 4<br>...<br>8<br>3 | 9½<br>...<br>8½<br>13 | 2<br>...<br>14<br>1 | 8<br>...<br>7<br>12½ | One or two specimens of *Loligo*, sp.; *Aurelia*, sp.; *Asterias*, sp.; and some weed. | At beginning—Wind W., force 6; weather, clear and fine; sea, rough; tide, fully 2 hours ebb; barometer, 29·27; transparency, 3 fathoms. |
| | W. 60·0 | 56·0 | 55·1 7 fath. | Bottom-net.—*Calanus*, sp. r.; *Dias*, sp. f.; *Temora*, sp. fr.; *Metridia armata*, r.; *Caligus*, sp. r.; young Gastropod Mollusca, f.; larval and young Crustacea, fr.; young Annelides, f.; young star fish, f.; (one or two *Nerine*, sp.). | | | | | | | | | At finish—Wind W force 6; weather, a little cloudy; tide, about ¾ ebb; barometer, 29·28; transparency, 3¼ fathoms. |
| STATION III. 25th August 6.15 a.m. to 8.5 a.m. | W. 56·5 | 56·2 | 55·2 6½ fath. | Surface-net. — *Virbius fasciger*, r.; *Dias longiremis*, f.; *Centropages*, sp. r.; larval Crustacea, fr.; post-larval fish, f. | Thornback ray,<br>Plaice,<br>″<br>Common dabs,<br>Com. gurnards, | 1<br>1<br>5<br>3<br>1 | 15<br>15<br>10½<br>9½<br>15 | ...<br>3<br>13<br>32<br>10 | ...<br>14<br>8½<br>8½<br>14 | ...<br>2<br>6<br>13<br>1 | ...<br>13<br>7<br>7½<br>5 | Several specimens of *Aurelia*, sp. and *Asterias*, sp. | At beginning—Wind W.S.W., force 4; weather, dull; sea, slight; tide, about high water; barometer 29·27; transparency, 2½ fathoms. |
| | E. 60·0 | 55·3 | 54·8 13 fath. | Bottom-net. — *Tauria*, sp. f.; *Atylus*, sp. f.; *Calanus*, sp. r.; *Dias*, sp. f.; *Temora*, sp. f.; *Centropages*, sp. f.; young Gastropods, f.; young Cephalopod, r.; larval and young Crustacea, ab.; young fish, r. | | | | | | | | | At finish—Wind W., force 5; weather, clear, fine; tide, about 2 hours ebb; transparency, 3 fathoms. |

TABLE C.—Record of Observations made on Board the 'Garland' during 1891.—II. St Andrews Bay—*continued.*

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Temperature. Water. Surface. | Temperature. Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station IV. 24th August 2.55 p.m. to 5.25 p.m. | E. 57·5 | 56·2 | 55·0 8 fath. | Surface-net.—*Eurydice pulchra*, f.; *Dias longiremis*, f.; *Temora longicornis*, f.; small Ctenophora, f.; larval Crustacea, f. Bottom-net. — *Atylus*, sp. f.; *Anomalocera patersonni*, f.; larval Crustacea, f. (very little in net). | Plaice, | 1 | 14 | 13 | 11 | 16 | 9 | *Aurelia*, several; weed | At beginning—Wind W.; weather, dull, inclining to rain; sea, moderate; tide, fully ¼ flood; barometer, 29·62; transparency, 2¼ fathoms. At finish — Wind W.S.W., force 4; tide, about high water; barometer, 29·57; transparency, 2 fathoms. |
| | | | | | ,, | 59 | 7 | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 1 | 12 | 2 | 10 | 7 | 9 | | |
| | | | | | ,, | 31 | 7½ | ... | ... | ... | ... | | |
| | | | | | Flounders, | 3 | 12½ | 1 | 11½ | 4 | 8½ | | |
| | W. 56·5 | 56·5 | 55·4 5½ fath. | | ,, | 3 | 7 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, | 6 | 14 | 6 | 12 | 4 | 11 | | |
| | | | | | ,, ,, | 4 | 8 | ... | ... | ... | ... | | |
| Station V. 24th August 12.40 p.m. to 2.20 p.m. | S. 60·0 | 55·3 | 54·8 13½ fath. | Surface-net.—*Dias longiremis*, f.; *Temora longicornis*, f.; *Anomalocera patersonni*, r.; small Ctenophora, r.; larval Crustacea, f.; fish ova, r. Bottom-net.—*Pseudocuma*, sp.; *Diastylis*, sp. fr.; *Caprella*, sp. r.; *Tauria*, sp. several; *Ampelisca*, sp. f.; *Atylus*, sp. f.; *Parathemisto*, sp. r.; *Calanus*, sp. r.; *Temora*, sp. fr.; *Centropages*, sp. f.; *Anomalocera patersonni*, f.; *Caligus*, sp. r.; *Sagitta*, sp. f.; *Tomopteris*, sp. f.; larval and young Gastropod and Lamellibranch Mollusca, c.; larval Crustacea, ab.; post-larval fish, fr. | Thornback ray, | 1 | 21 | ... | ... | ... | ... | *Loligo*, sp. f. (small); *Aurelia*, sp. f. | At beginning—Wind W.S.W., force 3; weather, dull; sea, easterly swell; tide, ¼ flood; barometer, 29·64; transparency, 3 fathoms. At finish — Wind S.S.W., force 4; tide, ½ flood; barometer and transparency as before. |
| | | | | | Plaice, | 1 | 16 | 9 | 13 | 11 | 10½ | | |
| | | | | | ,, | 25 | 9½ | 20 | 8 | 4 | 6½ | | |
| | | | | | Common dabs, | 6 | 10 | 12 | 9 | 35 | 7½ | | |
| | N. 59·0 | 56·0 | 54·8 13 fath. | | ,, ,, | 39 | 6 | 1 | 5 | 2 | 3½ | | |
| | | | | | Com. gurnards, | 3 | 13 | 6 | 11½ | 4 | 8 | | |
| | | | | | Cat-fish, | 1 | 39 | .. | ... | ... | ... | | |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1891.—II. ST ANDREWS BAY—*continued.*

| Station, Date, and Time Trawl down. | Temperature. | | | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. | | | | | | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Air. | Water. | | | | | | | | | | | |
| | Dry Bulb. | Surface. | Bottom. | | | No. | Inches | No. | Inches | No. | Inches | | |
| STATION I. 2nd October 2.5 p.m. to 4.15 p.m. | W. 58·9 | 53·6 | 52·8 7 fath. | Surface-net. — *Tauria*, sp. r.; *Idotea*, sp. r.; *Calanus finmarchicus*, f.; *Dias*, sp. fr.; *Sagitta*, sp. v. ab.; larval and young Crustacea, fr. | Plaice, | 3 | 15 | 5 | 14 | 4 | 11 | *Aurelia*, sp. and other large Medusidæ, c.; a quantity of weed. | At beginning—Wind S.E., light; weather, clear, fine; sea, smooth; tide, near high water; barometer, 29·77; transparency, 5 fathoms. |
| | | | | | ,, | 9 | 8-9 | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 2 | 12 | 1 | 11 | 4 | 9 | | |
| | | | | | ,, ,, | 4 | 5-7 | ... | ... | ... | ... | | |
| | E. 54·5 | 53·4 | 53·0 12½ fath. | Bottom-net.— *Pseudocuma* (?), r.; *Atylus bispinosus*, f.; *Calanus finmarchicus*, f.; *Temora longicornis*, f.; *Caligus rapax*, r.; *Sagitta*, sp. f.; post-larval Gastropods, f.; larva and young Crustacea, f.; young *Gadus*, sp. 1. | Whiting, | 1 | 10 | ... | ... | ... | ... | | At finish — Wind variable, light; tide, near 2 hours ebb; barometer, 29·80; transparency, 4½ fathoms. |
| | | | | | Com. gurnards, | 3 | 15 | 6 | 13 | 3 | 9 | | |
| STATION II. 2nd October 11.27 a.m. to 1.25 p.m. | W. 55·0 | 53·0 | 52·8 8 fath. | Surface-net.—*Atylus*, sp. f.; *Eurydice pulchra*, r.; *Idotea*, sp. r.; *Dias*, sp. fr.; larval and young Crustacea, f.; *Sagitta*, ab. | Thornback ray, | 1 | 21 | ... | ... | ... | ... | *Aurelia*, sp. and other large Medusidæ, ab.; some Cephalopod (*Loligo* ?), spawn; a considerable quantity of weed. | At beginning—Wind N.E., force 2; weather, clear; sea, slight; tide, about ½ flood; barometer, 29·73; transparency, 5 fathoms. |
| | | | | | Plaice, | 2 | 16 | 6 | 15 | 6 | 13 | | |
| | | | | | ,, | 13 | 8-10 | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 1 | 12 | 6 | 9 | 13 | 8 | | |
| | E. 55·0 | 53·0 | 53·0 12 fath. | Bottom-net.—*Calanus finmarchicus*, f.; *Dias*, sp. f.; *Temora longicornis*, f.; *Caligus*, sp. r.; *Sagitta*, sp. fr.; small Ctenophora, f.; larval Crustacea, f. | ,, ,, | 17 | 5-6 | ... | ... | ... | ... | | At finish — Wind S.E., force 1; tide, about 5 hours flood; barometer, 29·75; transparency, 5 fathoms. |
| | | | | | Haddock, | 1 | 26 | ... | ... | ... | ... | | |
| | | | | | Cod, | 1 | 11 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, | 2 | 16 | 4 | 13 | 1 | 10 | | |
| | | | | | ,, ,, | 3 | 6-8 | ... | ... | ... | ... | | |
| STATION III. 2nd October 9.35 a.m. to 11.10 a.m. | E. 52·0 | 52·4 | 53·0 11 fath. | Surface-net. — *Sagitta*, sp., in great abundance; young and larval Crustacea, fr. | Plaice, | 5 | 15 | 5 | 12 | 3 | 11 | *Gammarus*, sp. ab.; *Idotea*, sp. fr.; *Aurelia*, sp. and other large Medusids, c.; a considera- | At beginning—Wind N.E., force 3; weather, a little hazy; sea, slight; tide, first ¼ flood; barometer, 29·67; transparency, 4 fathoms. |
| | | | | | ,, | 38 | 8-9½ | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 3 | 12 | 3 | 10 | 38 | 8 | | |
| | | | | | ,, ,, | 49 | 4½-6 | ... | ... | ... | ... | | |
| | | | | Bottom-net. — *Calanus finmarchicus*, f.; *Dias*, sp. | Long rough dabs, | 2 | 9 | 2 | 8 | 1 | 6 | | |
| | | | | | Whiting, | 1 | 12 | ... | ... | ... | ... | | |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1891.—II. ST ANDREWS BAY—*continued.*

| Station, Date, and Time Trawl down. | Temperature. | | | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. | | | | | | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Air. | Water. | | | | | | | | | | | |
| | Dry Bulb. | Surface. | Bottom. | | | No. | Inches | No. | Inches | No. | Inches | | |
| STATION III. 2nd October 9.35 a.m. to 11.10 a.m. —*continued.* | W. 54·5 | 53·0 | 52·8 8 fath. | f.; *Temora longicornis*, f.; *Caligus*, sp. r.; *Sagitta*, sp. fr.; small Ctenophora, f.; larval Caustacea, f. | Com. gurnards, . | 1 | 13 | 4 | 12 | 1 | 14 | ble quantity of weed. | At finish — Wind N.E., force 2; tide, nearly ¼ flood; barometer, 29·72; transparency, 5½ fathoms. |
| | | | | | " " . | 2 | 11 | 3 | 7½ | 8 | 6 | | |
| | | | | | Butter fish, . | 1 | 4½ | ... | ... | ... | ... | | |
| STATION IV. 2nd October 7.7 a.m. to 9.10 a.m. | S.W. 49·7 | 52·4 | 52·9 4½ fath. | Surface-net. — *Gammarus*, sp. r.; *Sagitta*, sp. fr.; *Aurelia*, sp. and small Ctenophora, fr.; larval Crustacea, c.; a quantity of weed. | Plaice, . . | 2 | 13 | 3 | 12 | 9 | 10 | *Portunus holsatus*, f.; *Aurelia*, sp. f.; a considerable quantity of weed. | At beginning—Wind N.E., force 1; weather, hazy; sea, smooth; tide, last ¼ ebb; barometer, 29·61; transparency, 3½ fathoms. |
| | | | | | " . . | 25 | 7½–9 | ... | ... | ... | ... | | |
| | | | | | Common dabs, . | 1 | 12 | 3 | 10 | 4 | 8½ | | |
| | | | | | " " . | 3 | 6–7 | ... | ... | ... | ... | | |
| | N.E. 50·7 | 53·0 | 53·0 7½ fath. | Bottom-net.—*Calanus finmarchicus*, r.; *Caligus rapax*, r.; *Idotea marginata*, r.; *Sagitta*, sp. fr.; larval Crustacea, fr.; young Gastropod Mollusca, f. | Whitings, . . | 1 | 10 | 1 | 8 | ... | ... | | At finish — Wind N.E., force 3; tide, first ¼ flood; barometer, 29·66; transparency, 3½ fathoms. |
| | | | | | Com. gurnards, . | 2 | 13 | 2 | 12 | 1 | 11 | | |
| | | | | | " " . | 3 | 9 | ... | ... | ... | ... | | |
| | | | | | Angler, . . | 1 | 16 | ... | ... | ... | ... | | |
| STATION V. 1st October 3.17 p.m. to 4.50 p.m. | S. 54·4 | 53·2 | 52·9 15 fath. | Surface-net. — *Gammarus*, sp. f.; *Tauria*, sp. f.; *Calanus finmarchicus*, f.; *Dias*, sp. fr.; *Sagitta*, sp. c.; Ctenophora (small), fr. | Plaice, . . | 3 | 13 | 6 | 12 | 16 | 10 | *Loligo vulgaris*, r.; *Flustra*, sp. r.; *Asterias*, sp. f.; *Aurelia*, sp. r. | At beginning—Wind W., force 4; weather, a little hazy; sea, moderate; tide, first ¼ ebb; barometer, 29·45; transparency, 4½ fathoms. |
| | | | | | " . . | 15 | 8–9 | ... | ... | ... | ... | | |
| | | | | | Common dabs, . | 6 | 9 | 24 | 7 | 31 | 6 | | |
| | | | | | " " . | 35 | 4–5 | ... | ... | ... | ... | | |
| | N. 54·0 | 53·0 | 53·0 13½ fath. | Bottom-net.—*Eolis*, sp. r.; *Calisoma crenata*, f.; *Atylus bispinosus*, fr.; *Tauria*, sp. f.; *Calanus finmarchicus*, f.; *Temora*, sp. f.; *Dias*, sp. f.; *Caligus rapax*, r.; young Cephalopods, r.; young Gastropods, f.; young and larval Crustacea, fr.; *Sagitta*, sp. ab.; young fish, f. | Long rough dabs, | 1 | 9 | ... | ... | ... | ... | | At finish — Wind W.S.W., force 2; tide, ¼ ebb; barometer, 29·45; transparency, 4 fathoms. |
| | | | | | Haddocks, . . | 1 | 13 | 2 | 9 | 3 | 5 | | |
| | | | | | Whitings, . . | 1 | 10 | 1 | 8 | ... | ... | | |
| | | | | | Com. gurnards, . | 2 | 13 | 1 | 11 | 2 | 10 | | |
| | | | | | " " . | 6 | 8 | 2 | 7 | 1 | 5 | | |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1891.—II. ST ANDREWS BAY—*continued*.

| Station, Date, and Time Trawl down. | Temperature. | | | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. | | | | | | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Air. | Water. | | | | | | | | | | | |
| | Dry Bulb. | Surface. | Bottom. | | | No. | Inches | No. | Inches | No. | Inches | | |
| STATION I. 6th Nov. 2.33 p.m. to 4.33 p.m. | W. 48·0 | 48·5 | 49·3 7½ fath. | Surface-net.—*Idotea marina*, f.; *Parathemisto*, sp. f.; *Sagitta*, sp. f.; *Tomopteris*, sp. f.; *Ctenophora*, fr. Bottom-net.—*Parathemisto*, sp. f.; *Atylus bispinosus*, r.; *Calanus finmarchicus*, f.; *Temora longicornis*, f.; *Caligus rapax*, r.; *Sagitta*, sp. f.; *Tomopteris*, sp. fr.; Ctenophora, fr. | Starry ray, | 1 | 12 | ... | ... | ... | ... | *Portunus holsatus*, r.; *Eupagurus bernhardus*, r.; *Asterias*, sp. f.; *Flustra*, sp. r.; *Aurelia*, sp. r.; some weed. | At beginning—Wind W., force 4; weather, very hazy; sea, slight; tide, 3¾ hours flood; barometer, 30·36; transparency, 4 fathoms. At finish — Wind W.S.W., force 3; tide, 5¾ hours flood; barometer, 30·35; tranparency, 3¾ fathoms. |
| | | | | | Thornback ray, | 1 | 11 | ... | ... | ... | ... | | |
| | | | | | Plaice, | 1 | 16 | 9 | 14 | 3 | 11 | | |
| | | | | | Common dabs, | 3 | 11 | 33 | 7–8 | 45 | 4½–5½ | | |
| | E. 47·3 | 49·2 | 50·2 13 fath. | | Long rough dabs, | 1 | 9 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 3 | 5½ | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, | 1 | 15 | 3 | 13 | 1 | 11 | | |
| | | | | | ,, ,, | 1 | 8 | ... | ... | ... | ... | | |
| STATION II. 6th Nov. 12.20 p.m. to 2.12 p.m. | E. 48·0 | 49·4 | 50·2 12 fath. | Surface-net.—*Idotea marina*, f.; *Hippolyte fascigera*, (*Virbius fasciger*), r.; *Parathemisto*, sp. f.; *Caligus rapax*, r.; *Sagitta*, sp. f.; *Tomopteris*, sp. f.; Ctenophora, c. Bottom-net.—*Calanus finmarchicus*, f.; *Temora longicornis*, f.; *Caligus rapax*, fr.; *Sagitta*, sp. f.; Ctenophora, fr. | Starry ray, | 1 | 13 | 1 | 12 | 2 | 9 | *Loligo vulgaris*, r.; *Corystes cassivelaunus*, r.; *Stenorhynchus*, sp. r.; *Asterias*, sp. fr.; some weed. | At beginning—Wind N.W., force 2; weather, hazy; sea, slight; tide, 1¾ hours flood; barometer, 30·40; transparency, 4½ fathoms. At finish—Wind W., force 4; tide, 3½ hours flood; barometer, 30·37; transparency, 5 fathoms. |
| | | | | | ,, ,, | 1 | 5 | ... | ... | ... | ... | | |
| | | | | | Plaice, | 3 | 15 | 6 | 14 | 4 | 10½ | | |
| | | | | | ,, | 6 | 8–9 | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 3 | 10–11 | 43 | 8½–9½ | 122 | 7½ | | |
| | W. 47·0 | 48·8 | 49·3 9 fath. | | ,, ,, | 173 | 4½–5½ | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, | 6 | 13 | 2 | 10 | 1 | 7 | | |
| | | | | | Dragonet, | 1 | 8 | 1 | 7 | ... | ... | | |
| STATION III. 4th Nov. 9.55 a.m. to 11.30 a.m. | W. 46·6 | 49·0 | 49·9 6 fath. | Surface-net. — *Calanus finmarchicus*, f.; *Caligus rapax*, f.; Ctenophora, c.; young Crustacea, f. Bottom-net. — *Idotea marina*, r.; *Gammarus*, sp. r.; *Caligus rapax*, several; | Grey skate, | 1 | 16 | ... | ... | ... | ... | *Asterias*, sp. f.; *Amphidotus cordatus*, r.; *Aphrodite aculeata*, r.; some weed. | At beginning—Wind N.E., force 6; weather, overcast, rainy; sea, rough; tide, ¼ hour flood; barometer, 30·51; transparency, 5 fathoms. |
| | | | | | Starry ray, | 1 | 10 | ... | ... | ... | ... | | |
| | | | | | Thornback ray, | 1 | 19 | ... | ... | ... | ... | | |
| | | | | | Plaice, | 1 | 24 | 3 | 15-16 | 15 | 12–14 | | |
| | E. 46·8 | 49·0 | 50·5 12 fath. | | ,, | 16 | 9–10 | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 1 | 11 | 10 | 10 | 174 | 7-8½ | | |
| | | | | | ,, ,, | 117 | 4½–5½ | ... | ... | ... | ... | | |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1891.—II. ST ANDREWS BAY—*continued.*

| Station, Date, and Time Trawl down. | Temperature. Air. | Water. | | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. | | | | | | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Dry Bulb. | Surface. | Bottom. | | | No. | Inches | No. | Inches | No. | Inches | | |
| STATION III. 4th Nov. 9.55 a.m. to 11.30 a.m.—*continued.* | | | | *Sagitta*, sp. f.; Ctenophora, f.; young Crustacea, f. | Haddock, | 1 | 5 | ... | ... | ... | ... | | At finish — Wind N.E., force 7; tide, 2 hours flood; barometer, 30·52; transparency, 5½ fathoms. |
| | | | | | Whitings, | 1 | 13 | 1 | 10 | ... | ... | | |
| | | | | | Com. gurnards, | 3 | 15 | 14 | 12 | 3 | 10 | | |
| | | | | | " " | 25 | 6–7 | ... | ... | ... | ... | | |
| STATION IV. 4th Nov. 7.25 a.m. to 9.40 a.m. | N.E. 48·0 | 48·8 | 49·9 8 fath. | Surface-net. — *Gammarus*, sp. r.; *Calanus finmarchicus*, f.; *Caligus rapax*, f.; Ctenophora, ab.; young Crustacea, f. | Grey skate, | 1 | 17 | 1 | 14 | 1 | 13 | *Eupagurus bernhardus*, r.; young *Cancer pagurus*, r; *Asterias*, sp. f.; a considerable quantity of weed. | At beginning — Wind N.N.E., force 4; weather, overcast; sea, moderate; tide, 4 hours ebb; barometer, 30·48; transparency, 4 fathoms. |
| | | | | | Starry ray, | 1 | 8½ | ... | ... | ... | ... | | |
| | | | | | Thornback ray, | 1 | 22 | ... | ... | ... | ... | | |
| | | | | | Plaice, | 2 | 15 | 5 | 14 | 19 | 12 | | |
| | | | | | " | 95 | 8½–10 | ... | ... | ... | ... | | |
| | S.W. 48·9 | 49·0 | 49·3 6 fath. | Bottom-net. — *Gastrosaccus spinifer*, f.; *Macropsis slabberi*, f; *Calanus finmarchicus*, f.; *Caligus rapax*, fr.; *Sagitta*, sp. f.; Ctenophora, f.; young Crustacea, f. | Common dabs, | 1 | 11 | 15 | 10 | 55 | 7½–8½ | | At finish—Wind N.E., force 5; tide, ¼ hour flood; barometer, 30·51; transparency, 4¾ fathoms. |
| | | | | | " " | 81 | 5½–6½ | ... | ... | ... | ... | | |
| | | | | | Soles, | 1 | 20 | 1 | 18 | ... | ... | | |
| | | | | | Haddocks, | 1 | 20 | 1 | 10 | 1 | 9 | | |
| | | | | | " | 1 | 6 | ... | ... | ... | ... | | |
| | | | | | Cod, | 1 | 10 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 2 | 12 | 3 | 10 | 5 | 9 | | |
| | | | | | " | 19 | 4½–6 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, | 4 | 15 | 25 | 12 | 8 | 9–11 | | |
| | | | | | " " | 2 | 6 | ... | ... | ... | ... | | |
| | | | | | Herrings, | 2 | 4 | ... | ... | ... | ... | | |
| | | | | | Sprats, | 1 | 5 | 1 | 4 | ... | ... | | |
| STATION V. 3rd Nov. 12.40 p.m. to 2.55 p.m. | S. 48·8 | 49·6 | 50·9 15½ fath. | Surface-net.—*Parathemisto*, sp. f.; *Idotea marina*, v. r.; Ctenophora, c.; young *Motella*, 1; and *Syngnathus acus*, 1. Bottom-net.—*Calisoma*, sp. | Plaice, | 1 | 16 | 1 | 15 | 9 | 13 | *Asterias*, sp. f.; *Aurelia*, sp.; and other Medusidæ, f. | At beginning—Wind N.E., force 1; weather, overcast; sea, south easterly swell; tide, 3½ hours flood; bar- |
| | | | | | " | 46 | 9–10 | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 1 | 14 | 4 | 11 | 47 | 9 | | |
| | | | | | " " | 530 | 7 | 413 | 5½ | 17 | 4 | | |
| | | | | | Haddock, | 1 | 11 | ... | ... | ... | ... | | |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1891.—II. ST ANDREWS BAY—*continued*.

| Station, Date, and Time Trawl down. | Temperature. | | | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. | | | | | | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Air. | Water. | | | | | | | | | | | |
| | Dry Bulb. | Surface. | Bottom. | | | No. | Inches | No. | Inches | No. | Inches | | |
| STATION V. 3rd Nov. 12.40 p.m. to 2.55 p.m. —*continued*. | N. 48·6 | 50·0 | 50·7 14½ fath. | *Atylus bispinosus*, fr.; *Tauria*, sp. f.; *Calanus finmarchicus*, f.; *Temora longicornis*, f.; *Caligus*, sp. fr.; *Sagitta*, sp. c.; *Tomopteris*, sp. f.; Ctenophora, fr.; young fish, v. r. | Whiting, | 1 | 11 | ... | ... | .. | ... | | ometer, 30·48; transparency, 5 fathoms.<br>At finish — Wind calm; tide, 5¾ flood; barometer, 30·46; transparency, 4¾ fathoms. |
| | | | | | Com. gurnards, | 2 | 12 | 3 | 7½ | 26 | 6 | | |
| | | | | | Anglers, | 1 | 45 | 1 | 16 | ... | ... | | |
| | | | | | Dragonet, | 1 | 6½ | ... | ... | ... | ... | | |
| STATION I. 9th Dec. 1.20 p.m. to 3.30 p.m. | E. 44·0 | 45·7 | 8·5c 12 fath. | | Plaice, | 1 | 18 | 1 | 15 | 3 | 14 | | At beginning—Wind W., force 6; weather, squally; sea, rough, tide, 5 hours ebb; barometer, 29·11; transparency, 3¼ fathoms.<br>At finish — Tide, about 1 hour flood; barometer, 29·07; transparency, 2¼ fathoms. |
| | | | | | ,, | 1 | 12 | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 1 | 13 | 1 | 10 | 4 | 9 | | |
| | | | | | ,, ,, | 18 | 8 | 19 | 6 | 24 | 4½ | | |
| | | | | | Haddocks, | 1 | 11 | 2 | 6 | ... | ... | | |
| | W. 45·0 | 45·8 | 8·0 7 fath. | | Cod, | 1 | 12 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 1 | 10 | 1 | 5 | ... | ... | | |
| | | | | | Com. gurnards, | 1 | 13 | 14 | 7 | ... | ... | | |
| STATION III. 14th Dec. 11.0 a.m. to 12.50 p.m. | W. 41·0 | 43·8 | 7·3c 9 fath. | | Plaice, | 1 | 13 | ... | ... | ... | ... | | At beginning—Wind W., force 6; weather, clear; sea, rough from E.; tide, about ½ flood; barometer, 29·61; transparency, 3 fathoms.<br>At finish — Tide, 5 hours flood; barometer, 29·63; transparency, 3¼ fathoms. |
| | | | | | Common dabs, | 2 | 10 | 1 | 8 | 5 | 6 | | |
| | | | | | ,, ,, | 4 | 4 | ... | ... | ... | ... | | |
| | | | | | Haddocks, | 2 | 12 | 3 | 10 | 4 | 7 | | |
| | | | | | Whitings, | 2 | 8 | 1 | 7 | 13 | 6 | | |
| | E. 42·0 | 43·0 | 7·7 13 fath. | | ,, | 8 | 4 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, | 1 | 6 | ... | ... | ... | ... | | |
| | | | | | Sprats, | 1 | 5 | 10 | 4 | 3 | 3 | | |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1891.—II. ST ANDREWS BAY—*continued.*

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Temperature. Water. Surface. | Temperature. Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION IV. 14th Dec. 8.15 a.m. to 10.30 a.m. | N.E. 39·0<br>S.W. 41·0 | 43·7<br>43·5 | 7·8c 9 fath.<br>7·6c 7 fath. | Surface-net. — *Parathemisto oblivia*, v. ab.; (careful examination revealed no other organism). Bottom-net. — *Boreophausia*, sp. f.; *Macropsis slabberi*, fr.; *Parathemisto oblivia*, f.; *Calanus finmarchicus*, fr.; *Caligus rapax*, f.; *Sagitta*, sp. ab.; *Tomopteris*, sp. f.; Ctenophora (small), fr.; one young pipe-fish (*Syngnathus*). | Thornback ray, . | 1 | 8 | ... | ... | ... | ... | | At beginning—Wind W.N.W., force 5; weather, cloudy; sea, heavy from E.; tide, first of flood; barometer, 29·59; transparency, 2½ fathoms. At finish—Weather, clear; tide, nearly ½ flood; barometer, 29·60; transparency, 3 fathoms. |
| | | | | | Plaice, . . | 1 | 17 | 6 | 14 | ... | ... | | |
| | | | | | Common dabs, . | 3 | 11 | 6 | 7 | 7 | 4 | | |
| | | | | | Long rough dabs, | 2 | 9 | 1 | 8 | ... | ... | | |
| | | | | | Haddocks, . . | 1 | 24 | 3 | 22 | 7 | 20 | | |
| | | | | | ,, . . | 4 | 17 | 10 | 12 | 3 | 11 | | |
| | | | | | Cod, . . . | 1 | 31 | 1 | 30 | 2 | 27 | | |
| | | | | | Whiting . | 5 | 5 | ... | ... | ... | ... | | |
| | | | | | Sprats, . | 1 | 3 | 1 | 2 | ... | ... | | |
| | | | | | Conger, . . | 1 | 57 | ... | ... | ... | ... | | |

TABLE C.—Record of Observations made on Board the 'Garland' during 1891.—III. Montrose.

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Temperature. Water. Surface. | Temperature. Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station I. 28th August 8.15 a.m. to 10.0 a.m. | E. 55·0 | 55·0 | 53·9 17½ fath. | Surface-net.—*Calanus finmarchicus*, f.; *Temora longicornis*, fr.; *Centropages*, sp. r.; young Crustacea (*Porcellana*, *Hippolyte*), ab.; (little else than immature Crustacea). | Thornback ray, | 1 | 20 | 2 | 17 | ... | ... | | At beginning—Wind W.S.W., force 5; weather, clear; sea, rough; tide, nearly high water; barometer, 29·32; transparency, 3 fathoms. |
| | | | | | Plaice, | 12 | 15 | 8 | 12 | 9 | 10 | | |
| | | | | | " | 5 | 8 | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 2 | 10 | 55 | 8 | 20 | 6 | | |
| | | | | | " " | 11 | 5 | ... | ... | ... | ... | | |
| | | | | | Long rough dabs, | 1 | 13 | 8 | 11 | 8 | 8 | | |
| | W. 58·0 | 55·0 | 54·0 8½ fath. | Bottom-net.—*Boreophausia*, sp. r.; *Mysis*, sp. (juv.), r.; *Pseudocuma cercaria*, r.; *Atylus bispinosus*, r.; *Tauria medusarum*, r.; *Hyperia*, sp. r.; *Calanus finmarchicus*, c.; *Temora longicornis*, fr.; *Centropages*, sp. f.; *Sagitta*, sp. f.; *Tomopteris*, sp. f.; post-larval fish, several; young Gastropods, f.; larval and young Crustacea, fr.; young Ophiuridæ, fr. | " " | 3 | 7 | ... | ... | ... | ... | | At finish — Wind W.S.W., force 5; weather, clear and cloudy; sea, slight; tide, first ¼ ebb; barometer, 29·36; transparency, 3 fathoms. |
| | | | | | Haddocks, | 3 | 12 | 6 | 10 | ... | ... | | |
| | | | | | Cod, | 1 | 10 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, | 15 | 12 | 11 | 9 | 9 | 7 | | |
| Station II. 28th August 10.45 a.m. to 11.45 a.m. | E. 59·0 | 55·1 | 54·4 14 fath. | Surface-net.—*Parathemisto*, sp. r.; *Calanus finmarchicus*, fr.; *Sagitta*, sp. f.; larval and young Crustacea, c.; (little else than immature Crustacea). | Plaice, | 1 | 24 | 7 | 15 | 2 | 13 | | At beginning—Wind W.S.W., force 5; weather, clear; sea, rough; tide, 2 hours ebb; barometer, 29·38; transparency, 4 fathoms. |
| | | | | | " | 8 | 10 | 6 | 8 | ... | ... | | |
| | | | | | Common dabs, | 8 | 8 | 4 | 5 | ... | ... | | |
| | | | | | Long rough dabs, | 1 | 8 | ... | ... | ... | ... | | |
| | | | | | Haddocks, | 1 | 12 | 2 | 9 | ... | ... | | |
| | W. 58·0 | 55·2 | 54·5 6½ fath. | Bottom-net.—*Tauria medusarum*, r.; *Calanus finmarchicus*, c.; *Temora longicornis*, fr.; *Centropages*, sp. f. *Sagitta*, sp. fr.; *Tomopteris*, sp. fr.; post-larval fish, fr.; young Gastropods, f.; young and larval Crustacea, c.; young Ophiuridæ; fr. | Whiting, | 1 | 9 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, | 1 | 12 | 2 | 8½ | 4 | 5½ | | At finish — Wind W.S.W., force 6; weather, showery; sea rough; tide, about ½ ebb; barometer, 29·39; transparency, 3 fathoms. |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1891.—IV. ABERDEEN.

| Station, Date, and Time Trawl down. | Temperature. | | | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. | | | | | | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Air. | Water. | | | | | | | | | | | |
| | Dry Bulb. | Surface. | Bottom. | | | No. | Inches | No. | Inches | No. | Inches | | |
| STATION I. 3rd Sept. 11.45 a.m. to 1.45 p.m. | S.W. 57·0 | 53·5 | 53·0 8½ fath. | Bottom-net.—*Mysis spiritus*, f.; *Atylus bispinosus*, r.; *Atylus swammerdami*, f.; *Calanus finmarchicus*, f.; *Temora longicornis*, v. ab.; *pseudocalanus elongatus*, f.; *Dias longiremis*, f.; *Centropages*, sp. r.; *Caligus rapax*, f.; *Sagitta*, sp. f.; (an immense number of Copepoda consisting almost entirely of *Temora*). | Plaice, | 1 | 16 | 10 | 15 | 4 | 13 | | At beginning — Wind S.S.W., force 5; sea, rough; weather, a little hazy; barometer, 29·87; tide, ⅔ flood; transparency, 4 fathoms. At finish—Tide, first of ebb; barometer, 29·89; transparency, 5 fathoms. |
| | | | | | " | 4 | 9 | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 1 | 11 | 3 | 10 | 19 | 9 | | |
| | | | | | " " | 61 | 7½ | 29 | 6 | 49 | 5 | | |
| | | | | | Haddocks, | 2 | 17 | 1 | 14 | 4 | 13 | | |
| | N.E. 56·0 | 53·4 | 53·0 10 fath. | | " | 4 | 12 | 6 | 9 | ... | ... | | |
| | | | | | Cod, | 1 | 13 | 1 | 10 | 1 | 9 | | |
| | | | | | Whitings, | 4 | 12 | 16 | 11 | 15 | 10 | | |
| | | | | | " | 6 | 8 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, | 1 | 13 | 1 | 12 | 62 | 9 | | |
| | | | | | " " | 36 | 6 | 4 | 4½ | ... | ... | | |
| | | | | | Angler, | 1 | 12 | ... | ... | ... | ... | | |
| STATION II. 3rd Sept. 2.10 p.m. to 3.20 p.m. | W. 56·0 | 53·5 | 53·1 8½ fath. | Bottom-net.—*Mysis spiritus*, f.; *Pseudocuma cercaria*, f.; *Atylus bispinosus*, *Triphosa nana*, f.; *Tauria medusarum*, f.; *Calanus finmarchicus*, f.; *Temora longicornis*, v. ab.; *Pseudocalanus elongatus*, f.; *Dias longiremis*, f.; *Centropages*, sp. f.; *Caligus rapax*, f.; *Sagitta*, sp. fr.; young Gastropods, f.; young *Balani* and other Crustacea, f.; young Ophiuridæ, f. (an immense number of Copepoda, chiefly *Temora longicornis*). | Plaice, | 1 | 17 | 1 | 16 | 1 | 14 | | At beginning — Wind S.S.W., force 6; sea, rough; weather, hazy; tide, 1 hour ebb; barometer, 29·89; transparency, 5 fathoms. At finish—Wind S.S.W., force 6; tide, 2 hours ebb; barometer, 29·90; transparency, 5½ fathoms. |
| | | | | | " | 1 | 13 | 6 | 12 | 2 | 10 | | |
| | | | | | " | 1 | 8 | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 1 | 12 | 2 | 10 | 16 | 9 | | |
| | | | | | " " | 24 | 8 | 69 | 6 | 74 | 5 | | |
| | E. 55·0 | 53·5 | 53·0 19 fath. | | Long rough dabs, | 1 | 11 | 1 | 7 | ... | ... | | |
| | | | | | Haddocks, | 1 | 22 | 3 | 18 | 4 | 12 | | |
| | | | | | " | 7 | 10 | ... | ... | ... | ... | | |
| | | | | | Cod, | 1 | 20 | 2 | 9 | ... | ... | | |
| | | | | | Whitings, | 20 | 12 | 30 | 10 | 4 | 9 | | |
| | | | | | Com. gurnards, | 2 | 6 | 6 | 5 | 1 | 8 | | |
| | | | | | " " | 1 | 7 | ... | ... | ... | ... | | |
| | | | | | Angler, | 1 | 11 | ... | ... | ... | ... | | |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1891.—IV. ABERDEEN—*continued.*

| Station, Date, and Time Trawl down. | Temperature. | | | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. | | | | | | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Air. | Water. | | | | | | | | | | | |
| | Dry Bulb. | Surface. | Bottom. | | | No. | Inches | No. | Inches | No. | Inches | | |
| STATION III. 3rd Sept. 3.50 p.m. to 5.15 p.m. | E. 55·0 | 53·5 | 53·1 18 fath. | | Plaice, . . | 1 | 15 | 1 | 11 | 2 | 10 | | At beginning—Wind S.S.W., force 6; sea, rough; weather, hazy; tide, nearly ½ ebb; barometer, 29·90; transparency, 5 fathoms. At finish — Wind S.S.W., force 6; tide, 4 hours ebb; barometer, 29·90; transparency, 4 fathoms. |
| | | | | | " . . | 1 | 9 | ... | ... | ... | ... | | |
| | | | | | Common dabs, . | 4 | 9 | 4 | 8 | 16 | 7 | | |
| | | | | | " " . | 20 | 6 | 28 | 4½ | ... | ... | | |
| | | | | | Long rough dabs, | 1 | 10 | ... | ... | ... | ... | | |
| | W. 54·0 | 53·5 | 53·0 10 fath. | | Haddocks, . . | 1 | 17 | 1 | 14 | 7 | 12 | | |
| | | | | | " . . | 9 | 10 | ... | ... | ... | ... | | |
| | | | | | Whitings, . . | 1 | 13 | 3 | 12 | 32 | 11 | | |
| | | | | | " . . | 54 | 10 | 28 | 9 | 4 | 8 | | |
| | | | | | Com. gurnards, . | 1 | 11 | 2 | 8 | 3 | 6 | | |
| | | | | | Angler, . . | 1 | 18 | ... | ... | ... | ... | | |
| STATION IV. 5th Sept. 8.45 a.m. to 10.15 a.m. | S.W. 53·0 | 53·5 | 53·3 8 fath. | Bottom-net.—*Mysis spiritus*, f.; *Mysis ornatus*, r.; *Pseudocuma cercaria*, c.; *Monoculus longimanus*, r.; *Atylus bispinosus*, r.; *Atylus swammerdami*, r.; *Hyperia*, sp.r.; *Calanus finmarchicus*, f.; *Temora longicornis*, v. ab.; *Pseudocalanus elongatus*, f.; *Dias longiremis*, *Pleuromma* (*Metridia*) *armata*, f.; *Centropages hamatus*, r.; *Parapontella brevicornis*, r.; *Longipedia coronata*, r.; *Alteutha depressa*, r.; *Lichomolgus*, sp. r.; *Caligus rapax*, r.; young Gastropods, f.; larval and young Crustacea, f.; young Ophiuridæ, f.; (an immense number of Copepoda, chiefly *Temora*). | Plaice, . . | 1 | 18 | 2 | 15 | 1 | 14 | | At beginning—Wind S.S.W., force 4½; weather, hazy; sea, slight S.S.W.; tide, first of flood; barometer, 29·87; transparency, 3 fathoms. At finish — Wind S.S.W., force 5; sea, rough; tide, ¼ flood; barometer, 29·86; transparency, 3½ fathoms. |
| | | | | | " . . | 1 | 11 | 4 | 10 | ... | ... | | |
| | | | | | Common dabs, . | 3 | 9 | 7 | 7 | 24 | 5 | | |
| | | | | | Haddocks, . . | 1 | 17 | 1 | 14 | 4 | 13 | | |
| | | | | | " . . | 5 | 12 | 28 | 10 | 9 | 9 | | |
| | N.E. 54·0 | 53·5 | 53·0 11½ fath. | | Cod, . . | 2 | 13 | 2 | 9 | ... | ... | | |
| | | | | | Whitings, . . | 1 | 13 | 33 | 12 | 63 | 10 | | |
| | | | | | " . . | 53 | 8 | 4 | 4 | ... | ... | | |
| | | | | | Com. gurnards, . | 1 | 11 | 2 | 6 | ... | ... | | |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1891.—IV. ABERDEEN—*continued.*

| Station, Date, and Time Trawl Down. | Temperature. Air. Dry Bulb. | Water. Surface. | Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION V.<br>4th Sept.<br>3.35 p.m. to<br>5.30 p.m. | N.E.<br>55·0<br><br>S.W.<br>54·0 | 53·6<br><br>53·7 | 53·2<br>9<br>fath.<br>53·4<br>8<br>fath. | Bottom-net.—***Mysis spiritus***, f.; *Pseudocuma cercaria*, c.; *Atylus swammerdami*, fr.; *Hyperia*, sp. f.; *Calanus finmarchicus*, f.; *Pseudocalanus elongatus*, f.; *Temora longicornis*, v. ab.; *Pleuromma* (*Metridia*) *armata*, f.; *Centropages hamatus*, fr.; *Parapontella brevicornis*, f.; *Sagitta*, sp. f.; young Gastropods, f.; *Balani* (Copepod-stage) and other larval and young Crustacea, f.; (an immense number of Copepods, chiefly *Temora longicornis*). | Grey skate, . | 1 | 15 | ... | ... | ... | ... | | At beginning — Wind S., force 3; weather, hazy; sea, slight southerly; tide, 2 hours ebb; barometer, 29·90; transparency, 2½ fathoms.<br>At finish—Wind S., force 3; weather, showery; sea, slight southerly; tide, nearly 4 hours ebb; barometer, 29·90; transparency, 2 fathoms. |
| | | | | | Thornback ray, . | 1 | 19 | 2 | 9 | ... | ... | | |
| | | | | | Plaice, . . | 8 | 20 | 2 | 17 | 18 | 15 | | |
| | | | | | ,, | 11 | 12 | 23 | 9 | 8 | 7 | | |
| | | | | | Common dabs, . | 1 | 18 | 8 | 10 | 8 | 9 | | |
| | | | | | ,, ,, . | 8 | 7 | 5 | 5 | ... | ... | | |
| | | | | | Flounders, . | 1 | 14 | 2 | 12 | 2 | 11 | | |
| | | | | | ,, . . | 7 | 10 | ... | ... | ... | ... | | |
| | | | | | Haddocks, . | 1 | 19 | 1 | 17 | 3 | 14 | | |
| | | | | | ,, . . | 8 | 18 | 8 | 11 | 11 | 9 | | |
| | | | | | Whitings, . | 2 | 15 | 1 | 18 | 42 | 11 | | |
| | | | | | ,, . . | 94 | 9 | 12 | 7 | ... | ... | | |
| | | | | | Saithe, . | 1 | 7 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, . | 1 | 10 | ... | ... | ... | ... | | |
| | | | | | Herrings, . | 1 | 10 | ... | ... | ... | ... | | |
| STATION VI.<br>4th Sept.<br>1.50 p.m.<br>to 3.10 p.m. | N.E.<br>55·0<br><br>S.W.<br>55·3 | 53·5<br><br>53·5 | 53·1<br>13½<br>fath.<br>53·0<br>16½<br>fath. | | Plaice, . . | 1 | 17 | 3 | 14 | 1 | 13 | | At beginning—Wind S.S.W., force 4; weather, hazy; sea, strong S. swell; tide, high water; barometer, 29·90; transparency, 3½ fathoms.<br>At finish—Wind S., force 3; weather, hazy; sea, moderate, S. swell; tide, first ½ ebb; barometer, 29·90; transparency, 3 fathoms |
| | | | | | ,, . . | 2 | 10 | ... | ... | ... | ... | | |
| | | | | | Common dabs, . | 1 | 12 | 16 | 9 | 106 | 6 | | |
| | | | | | ,, ,, . | 30 | 5 | ... | ... | ... | ... | | |
| | | | | | Haddocks, . | 2 | 15 | 8 | 13 | 39 | 11 | | |
| | | | | | ,, . . | 91 | 9 | 27 | 7 | ... | ... | | |
| | | | | | Cod, . . | 1 | 16 | 2 | 10 | ... | ... | | |
| | | | | | Whitings, . | 2 | 15 | 4 | 14 | 60 | 12 | | |
| | | | | | ,, . . | 117 | 10 | 54 | 8 | ... | ... | | |
| | | | | | Com. gurnards, . | 1 | 9 | ... | ... | ... | ... | | |
| | | | | | Anglers, . | 1 | 21 | 1 | 18 | ... | ... | | |

TABLE C.—Record of Observations made on Board the 'Garland' during 1891.—IV. Aberdeen—*continued.*

| Station, Date, and Time Trawl down. | Temperature. | | | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. | | | | | | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Air. | Water. | | | | | | | | | | | |
| | Dry Bulb. | Surface. | Bottom. | | | No. | Inches | No. | Inches | No. | Inches | | |
| Station VII. | N.E. | 53·5 | 52·9 | | Plaice, | 1 | 21 | 1 | 18 | 1 | 15 | | At beginning—Wind S.W., force 3; weather, hazy; sea, strong southerly swell; tide, nearly ½ flood; barometer, 29·91; transparency, 4¼ fathoms. At finish — Wind S.W., force 4; tide, nearly high water; barometer, 29·90; transparency, 4 fathoms. |
| 4th Sept. | 56·0 | | 29 | | " | 1 | 14 | ... | ... | ... | ... | | |
| 10.55 a.m. | | | fath. | | Lemon sole, | 1 | 8 | ... | ... | ... | ... | | |
| to 1.20 p.m. | | | | | Common dabs, | 1 | 11 | 2 | 10 | 2 | 9 | | |
| | | | | | " | 2 | 8 | 3 | 6 | 2 | 5 | | |
| | S.W. | 53·3 | 53·0 | | Haddocks, | 1 | 21 | 3 | 19 | 15 | 15 | | |
| | 55·5 | | 29 | | " | 38 | 12 | 231 | 10 | 187 | 8 | | |
| | | | fath. | | Cod, | 1 | 18 | 3 | 11 | 3 | 10 | | |
| | | | | | Whitings, | 5 | 14 | 119 | 12 | 526 | 10 | | |
| | | | | | " | 45 | 8 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, | 2 | 10 | 2 | 8 | 1 | 7 | | |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1891.—V. MORAY FIRTH.

| Station, Date, and Time Trawl down. | Temperature. | | | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. | | | | | | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Air. | Water. | | | | | | | | | | | |
| | Dry Bulb. | Surface. | Bottom. | | | No. | Inches | No. | Inches | No. | Inches | | |
| STATION I. 8th Sept. 11.45 a.m. to 1.35 p.m. | E. 59·0 | 54·0 | 53·0 9½ fath. | Bottom-net. — *Calanus finmarchicus*, fr.; *Pseudocalanus elongatus*, fr.; *Temora longicornis*, fr.; small Ctenophora, f.; larval and young Crustacea, fr.; young Ophiuridæ, f.; one or two post-larval fish (comparatively little). | Plaice, | 1 | 17 | 1 | 16 | 1 | 15 | | At beginning—Wind S., force 4; weather, clear; sea, moderate; tide, nearly ½ flood; barometer, 29·98; transparency, 6½ fathoms. At finish — Wind S.W., force 2; tide, ¾ flood; barometer, 29·96; transparency, 7 fathoms. |
| | | | | | Common dabs, | 2 | 8 | 7 | 6 | 4 | 5 | | |
| | | | | | „ „ | 5 | 4 | ... | ... | ... | ... | | |
| | | | | | Haddocks, | 2 | 17 | 2 | 14 | 1 | 12 | | |
| | | | | | Com. gurnards, | 14 | 8 | 4 | 5 | ... | ... | | |
| | W. 64·0 | 54·1 | 53·0 10 fath. | | Dragonet, | 1 | 7 | ... | ... | ... | ... | | |
| STATION II. 8th Sept. 2.30 p.m. to 4.20 p.m. | E. 63·4 | 54·9 | 51·9 20 fath. | | Thornback ray, | 1 | 15 | ... | ... | ... | ... | | At beginning — Wind S.W., force 3; weather, clear; sea, slight; tide, nearly high water; barometer, 29·94; transparency, 5 fathoms. At finish—Wind W.S.W., force 1; weather, clear; sea, smooth; tide, ½ ebb; barometer, 29·94; transparency. 4½ fathoms. |
| | | | | | Plaice, | 1 | 21 | 6 | 13 | 10 | 11 | | |
| | | | | | „ | 8 | 9 | 3 | 7½ | ... | ... | | |
| | | | | | Lemon soles, | 1 | 13 | 1 | 10 | 2 | 8 | | |
| | | | | | „ „ | 3 | 7 | 5 | 5 | ... | ... | | |
| | W. 63·0 | 54·5 | 52·0 13½ fath. | | Common dabs, | 3 | 9 | 22 | 8 | 43 | 7 | | |
| | | | | | „ „ | 40 | 5½ | 45 | 4½ | 36 | 3½ | | |
| | | | | | Witch soles, | 14 | 17 | 16 | 14 | 8 | 12 | | |
| | | | | | „ „ | 3 | 10 | 5 | 9 | 2 | 7 | | |
| | | | | | „ „ | 1 | 4 | ... | ... | ... | ... | | |
| | | | | | Flounders, | 1 | 13 | 1 | 10 | 1 | 8 | | |
| | | | | | Long rough dabs, | 1 | 11 | 7 | 10 | 21 | 8 | | |
| | | | | | „ „ | 6 | 7 | 11 | 5 | 5 | 4 | | |
| | | | | | Haddock, | 1 | 17 | ... | ... | ... | ... | | |
| | | | | | Cod, | 3 | 9 | ... | ... | ... | ... | | |
| | | | | | Whitings, | 1 | 14 | 1 | 12 | 3 | 10 | | |
| | | | | | „ | 6 | 8 | 4 | 7 | ... | ... | | |
| | | | | | Hake, | 1 | 14 | 1 | 13 | 1 | 12 | | |

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1891.—V. MORAY FIRTH—*continued.*

| Station, Date, and Time Trawl down. | Temperature: Air. Dry Bulb. | Temperature: Water. Surface. | Temperature: Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION II. 8th Sept. 2.30 p.m. to 4.20 p.m. —*continued.* | | | | | Hake . . | 2 | 9 | 3 | 8 | ... | ... | | |
| | | | | | Com. gurnards, . | 2 | 14½ | 1 | 13 | 2 | 12 | | |
| | | | | | ,, ,, . | 3 | 11 | 15 | 7 | 6 | 5 | | |
| | | | | | Anglers, . . | 2 | 18 | ... | ... | ... | ... | | |
| | | | | | Dragonet, . . | 1 | 6 | ... | ... | ... | ... | | |
| | | | | | Pogge, . . | 1 | 4 | ... | ... | ... | ... | | |
| STATION III. 10th Sept. 2.0 p.m. to 3.15 p.m. | E. 62·0 | 53·9 | 53·2 11 fath. | Surface-net.—*Mysis flexuosus*, r.; *Hyperia medusarum*, r.; *Calanus finmarchicus*, f.; *Temora longicornis*, fr.; *Dias longiremis*, f.; *Centropages hamatus*, f.; young Gastropods, f.; larval and young Crustacea, f.; *Sagitta*, r. Bottom-net.—*Pseudocuma*, sp. r.; *Atylus swammerdami*, f.; *Parathemisto oblivia*, r.; *Calanus finmarchicus*, f.; *Temora longicornis*, f.; *Dias longiremis*, fr.; *Pseudocalanus elongatus*, f.; *Centropages hamatus*, f.; *Parapontella brevicornis*, fr.; *Oithona spinifrons*, f.; larval and young Crustacea, fr.; one young pipe-fish (*Syngnathus*). | Thornback ray, . | 1 | 26 | 1 | 21 | ... | ... | | At beginning—Wind calm; weather, showery; sea, smooth; tide, ¾ flood; barometer, 29·96; transparency, 4 fathoms. At finish — Wind S., force 2; tide, nearly high water; barometer, 29·96; transparency, 3 fathoms. |
| | | | | | Plaice, . . | 2 | 24 | 2 | 20 | 6 | 18 | | |
| | | | | | ,, . . | 3 | 15 | 11 | 13 | 22 | 10 | | |
| | | | | | ,, . . | 3 | 9 | ... | ... | ... | ... | | |
| | | | | | Lemon soles, . | 1 | 18 | 1 | 13 | 3 | 10 | | |
| | | | | | Cod, . . . | 2 | 12 | 1 | 8 | 1 | 6 | | |
| | | | | | Com. gurnard, . | 1 | 7 | ... | ... | ... | ... | | |
| | W. 64·0 | 55·0 | 53·0 10 fath. | | Father-lasher, . | 1 | 8½ | 2 | 5½ | ... | ... | | |

TABLE C.—Record of Observations made on Board the 'Garland' during 1891.—V. Moray Firth—*continued*.

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Temperature. Water. Surface. | Temperature. Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION IV. 9th Sept. 12.15 p.m. to 2.15 p.m. | N.E. 55·0 | 53·5 | 52·9 11 fath. | Bottom-net. — *Calanus finmarchicus*, fr.; *Pseudocalanus elongatus*, f.; *Temora longicornis*, c.; *Pseudocuma cercaria*, f.; *Tomopteris*, sp. f.; Ctenophora (small), fr.; a few post-larval fish. | Thornback ray, | 1 | 19 | ... | ... | ... | ... | | At beginning—Wind E.N.E., force 3; weather, raining; sea, slight E. swell; tide, about ¼ flood; barometer, 29·94; transparency, 5½ fathoms. At finish — Wind calm; weather, dull and cloudy; sea, smooth; tide, about 5 hours flood; barometer, 29 90; transparency, 5 fathoms. |
| | | | | | Plaice, | 1 | 22 | 1 | 21 | 1 | 20 | | |
| | | | | | ” | 1 | 18 | 1 | 17 | 3 | 15 | | |
| | | | | | ” | 8 | 12 | 35 | 10 | 36 | 8½ | | |
| | | | | | ” | 24 | 6½ | ... | ... | ... | ... | | |
| | S.W. 58·0 | 53·7 | 53·0 10 fath. | | Common dabs, | 2 | 12 | 1 | 11 | 5 | 10 | | |
| | | | | | ” ” | 34 | 8½ | 58 | 6½ | 22 | 5 | | |
| | | | | | Haddock, ” | 1 | 5 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, | 1 | 15 | 1 | 11 | 3 | 8 | | |
| | | | | | ” ” | 5 | 6 | ... | ... | ... | ... | | |
| STATION V. 9th Sept. 2.35 p.m. to 4.25 p.m. | W. 58·0 | 54·0 | 52·4 13 fath. | Bottom-net. — *Hyperia*, sp. f.; *Anceus maxillaris* ♀, r.; *Calanus finmarchicus*, f.; *Pseudocalanus elongatus*, f.; *Temora longicornis*, ab.; *Centropages hamatus*, f.; *Podon*, sp. fr.; *Tomopteris*, f.; small Ctenophora, fr.; young and larval Crustacea, f.; post-larval fish, f. | Plaice, | 2 | 18 | 4 | 15 | 2 | 13 | | At beginning—Wind S.W., force 2; weather, dull and cloudy; sea, slight E. swell; tide, nearly high water; barometer, 29·90; transparency, 5 fathoms. At finish — Wind W.S.W., force 3; weather, cloudy; sea, slight E. swell; tide, first ¼ ebb; barometer, 29·91; transparency, 5 fathoms. |
| | | | | | ” | 5 | 11 | 5 | 8 | ... | ... | | |
| | | | | | Lemon sole, | 1 | 8½ | ... | ... | ... | ... | | |
| | | | | | Common dabs, | 1 | 12 | 2 | 10 | 42 | 9 | | |
| | | | | | ” ” | 229 | 7 | 188 | 5½ | 14 | 4 | | |
| | E. 59·0 | 54·5 | 52·0 13 fath. | | Flounder, | 2 | 7½ | ... | ... | ... | ... | | |
| | | | | | Haddocks, | 1 | 17 | 1 | 16 | 1 | 15 | | |
| | | | | | ” | 1 | 14 | 4 | 12 | 1 | 5 | | |
| | | | | | Whitings, | 3 | 11 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, | 1 | 15 | 3 | 13 | 6 | 12 | | |
| | | | | | ” ” | 16 | 8 | 6 | 7 | ... | ... | | |

TABLE C.—Record of Observations made on Board the 'Garland' during 1891.—V. Moray Firth—*continued.*

| Station, Date, and Time Trawl down. | Temperature. Air. Dry Bulb. | Temperature. Water. Surface. | Temperature. Water. Bottom. | Pelagic Fauna, Spawn, and young Fish. | Description of Take. | Number and Size of Fish. No. | Inches | No. | Inches | No. | Inches | Invertebrate Fauna, &c. brought up in Trawl Net. | Wind, Weather, and other Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station VI. 9th Sept. 9.50 a.m. to 11.40 a.m. | E. 56·0 | 54·0 | 52·0 18 fath. | Bottom-net.—*Tryphosa nana*, f.; *Parathemisto oblivia*, f.; *Calanus finmarchicus*, f.; *Pseudocalanus elongatus*, f.; *Temora longicornis*, ab.; *Centropages hamatus*, sp. fr.; *Caligus rapax*, f.; *Anceus maxillaris* ♀, r.; *Podon*, f.; *Sagitta*, sp. f.; *Nerine*, sp. r.; young Gastropods, f.; young and larval Crustacea, f. | Thornback ray, | 1 | 21 | 1 | 19 | ... | ... | | At beginning — Wind E.N.E., force 2; weather, dull and cloudy; sea, slight; E. swell; tide, about 1 hour flood; barometer, 29·94; transparency, 4½ fathoms. At finish—Wind S., force 1; weather, showery; sea, smooth; tide, nearly ¼ flood; barometer, 29·95; transparency, 5½ fathoms. |
| | | | | | Plaice, | 1 | 25 | 2 | 21 | 2 | 18 | | |
| | | | | | " | 1 | 15 | 1 | 11 | 1 | 8 | | |
| | | | | | Lemon soles, | 1 | 16 | 1 | 13 | 1 | 12 | | |
| | | | | | " " | 2 | 11 | 1 | 10 | 3 | 8 | | |
| | W. 57·0 | 53·5 | 52·6 11 fath. | | Common dabs, | 4 | 9 | 24 | 8 | 32 | 6½ | | |
| | | | | | " " | 31 | 4½ | ... | ... | ... | ... | | |
| | | | | | Haddocks, | 1 | 16 | 1 | 15 | ... | ... | | |
| | | | | | Cod, | 1 | 36 | 1 | 35 | 1 | 14 | | |
| | | | | | " | 4 | 12 | 9 | 10 | ... | ... | | |
| | | | | | Brassie, | 1 | 7 | ... | ... | ... | ... | | |
| | | | | | Ling, | 1 | 19 | ... | ... | ... | ... | | |
| | | | | | Com. gurnards, | 2 | 12 | 2 | 11 | 5 | 10 | | |
| | | | | | " " | 9 | 8 | 2 | 4½ | . | ... | | |
| | | | | | Angler, | 1 | 28 | 1 | 20 | ... | ... | | |

TABLE D.—ANSTRUTHER DISTRICT.—Buckhaven Haddock and Cod Line Fishing—Years 1890–91.

| Months. | 1890. | | | | | | | | 1891. | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Number of Days Boats were out per Month. | Total Number of Shots per Month. | Haddocks and Whitings. | | Number of Cod. | Average Number of Fish per Shot. | | | Number of Days Boats were out per Month. | Total Number of Shots per Month. | Haddocks and Whitings. | | Number of Cod. | Average Number of Fish per Shot. | | |
| | | | | | | Haddocks and Whitings. | | Cod. | | | | | | Haddocks and Whitings. | | Cod. |
| | | | 100's of Large. | 100's of Small. | | Large. | Small. | | | | 100's of Large. | 100's of Small. | | Large. | Small. | |
| January, . . | 22 | 171 | 65⅓ | 44 | 203 | 49·02 | 32·9 | 1·18 | 24 | 276 | 188 | 123 | 642 | 87·1 | 57·04 | 2·32 |
| February, . . | 19 | 133 | 48⅓ | 27½ | 202 | 46·6 | 26·4 | 1·52 | 21 | 227 | 189 | 126 | 250 | 106·5 | 71·04 | 1·10 |
| March, . . . | 19 | 283 | 78 | 70 | 148 | 35·2 | 31·6 | 0·505 | 19 | 242 | 185 | 135 | 463 | . 97·8 | 71·4 | 1·91 |
| April, . . . | 25 | 535 | 187 | 143 | 161 | 44·7 | 34·2 | 0·30 | 23 | 482 | 473 | 168 | 769 | 125·6 | 44·6 | 1·59 |
| May, . . . | 25 | 158 | 44 | 117 | 58 | 35·6 | 94·7 | 0·36 | 26 | 271 | 299 | 173 | 70 | 141·2 | 81·7 | 0·25 |
| June, . . . | 25 | 151 | 49 | 398 | 75 | 41·5 | 337·3 | 0·49 | 24 | 167 | 258 | 162 | - | 197·7 | 124·1 | - |
| July, . . . | 25 | 185 | 35 | 665 | 63 | 24·2 | 460·1 | 0·34 | 27 | 196 | 303 | 352 | - | 197·8 | 229·8 | - |
| August, . . | 23 | 176 | 68 | 512 | 48 | 49·4 | 372·3 | 0·21 | 24 | 201 | 129 | 290 | - | 82·1 | 184·6 | - |
| September, . . | 23 | 262 | 49 | 598 | - | 23·8 | 292·1 | - | 20 | 165 | 81 | 245 | - | 62·8 | 190·06 | - |
| October, . . | 26 | 513 | 660 | 815 | 176 | 164·6 | 78·5 | 0·34 | 25 | 436 | 297 | 279 | - | 87·19 | 81·9 | - |
| November, . . | 22 | 431 | 484 | 260 | 347 | 143·7 | 77·2 | 0·805 | 22 | 363 | 161 | 232 | 165 | 56·7 | 81·8 | 0·45 |
| December, . . | 24 | 398 | 323 | 300 | 1000 | 103·8 | 96·4 | 2·51 | 24 | 270 | 111 | 107 | 670 | 52·6 | 50·7 | 2·4 |
| Totals for Year, | 278 | 3396 | 2091 | 3449½ | 2476 | 78·8 | 130·5 | 0·72 | 279 | 3296 | 2674 | 2392 | 3029 | 108·8 | 92·8 | 0·91 |

*Note.*—'Large' fish are Haddocks only; 'Small' includes Whitings and (principally) Small Haddocks. One hundred fish is 32 warp or 128 fish. The total number of shots per month is ascertained by adding together the number of boats out each day.

TABLE E.—Showing Fish Landed by Net and Line Boats and by Steam Beam Trawl Boats during 1891, in the Leith, Anstruther, Montrose, Stonehaven, and Aberdeen Districts.

| Date. | District. | Herring. | Sprat. | Sparling. | Mackerel. | Cod. | Ling. | Torsk (Tusk). | Saithe (Coalfish). | Haddock. | Whiting. | Turbot. | Halibut. | Sole (Lemon Sole). | Flounder, Plaice, Brill. | Eel. | Skate. | Other kinds of White Fish. | Oysters. | Mussels. | Clams. | Lobsters. | Crabs. | Other kinds of Shell Fish. | Total Value. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | 100s | cwt. | cwt. | 100s. | 100s | cwt. | £ |
| 1891 | **Leith District.** | | | | | | | | | | | | | | | | | | | | | | | | |
| Jan. | I. Net and line boats, . | 2727 | – | 3 | – | 8907 | 242 | 1 | 72 | 5047 | 587 | 3 | 6 | – | 148 | 27 | 257 | 1348 | 53 | 1521 | 5416 | – | 339 | 141 | 11,062 |
| | II. Steam beam trawlers, | – | – | – | – | 1480 | 55 | – | 39 | 4488 | 1000 | 152 | 1 | 131 | 801 | 9 | 787 | 1479 | – | – | – | – | – | 28 | 5,160 |
| | Total, . | 2727 | – | 3 | – | 10,387 | 297 | 1 | 111 | 9535 | 1587 | 155 | 7 | 131 | 949 | 36 | 1044 | 2827 | 53 | 1521 | 5416 | – | 339 | 169 | 16,222 |
| Feb. | I. Net and line boats, . | 9404 | 3 | 5½ | – | 3845 | 188 | – | 82 | 5467 | 601 | 7 | 4 | 2 | 382 | 34 | 158 | 988 | 62 | 2045 | 4700 | – | 244 | 187 | 9,204 |
| | II. Steam beam trawlers, | – | – | – | – | 1225 | 47 | – | 25 | 3750 | 422 | 89 | 2 | 176 | 1015 | 6 | 344 | 1467 | – | – | – | – | – | 20 | 3,975 |
| | Total, . | 9404 | 3 | 5½ | – | 5070 | 235 | – | 107 | 9217 | 1023 | 96 | 6 | 178 | 1397 | 40 | 502 | 2455 | 62 | 2045 | 4700 | – | 244 | 207 | 13,179 |
| March | I. Net and line boats, . | 2383 | 120 | 7½ | – | 1164 | 82 | – | 42 | 2580 | 296 | 6 | 3 | 1 | 160 | 2 | 135 | 343 | 55 | 2960 | 2840 | – | 260 | 127 | 5,229 |
| | II. Steam beam trawlers, | – | – | – | – | 1472 | 39 | – | 6 | 1830 | 334 | 20 | – | 71 | 217 | 1 | 86 | 505 | – | – | – | – | – | 13 | 2804 |
| | Total, . | 2383 | 120 | 7½ | – | 2636 | 121 | – | 48 | 4410 | 630 | 26 | 3 | 72 | 377 | 3 | 221 | 848 | 55 | 2960 | 2840 | – | 260 | 140 | 8,033 |
| April | I. Net and line boats, . | 244 | 10 | 12½ | – | 4800 | 308 | – | 161 | 2964 | 524 | 12 | 18 | 8 | 257 | 9½ | 303 | 1649 | 34 | 2540 | 2605 | 4·58 | 830 | 163 | 7559 |
| | II. Steam beam trawlers, | – | – | – | – | 3659 | 68 | – | 29 | 1594 | 504 | 101 | 2 | 202 | 392 | 1 | 273 | 1015 | – | – | – | – | – | 46 | 4008 |
| | Total, . | 244 | 10 | 12½ | – | 8459 | 376 | – | 190 | 4558 | 1028 | 113 | 20 | 210 | 649 | 10½ | 576 | 2664 | 34 | 2540 | 2605 | 4·58 | 830 | 209 | 11,567 |
| May | I. Net and line boats, . | 782 | – | – | – | 4648 | 791 | – | 1348 | 2232 | 433 | 33 | 194 | 4 | 308 | 13 | 335 | 1347 | – | 1650 | 630 | 9·53 | 2249 | 189 | 7647 |
| | II. Steam beam trawlers, | – | – | – | – | 1792 | 74 | – | 60 | 2596 | 323 | 53 | 4 | 265 | 366 | – | 128 | 1282 | – | – | – | – | – | 100 | 3821 |
| | Total, . | 782 | – | – | – | 6440 | 865 | – | 1408 | 4828 | 756 | 86 | 198 | 269 | 674 | 13 | 463 | 2629 | – | 1650 | 630 | 9·53 | 2249 | 289 | 11,468 |

TABLE E.—Showing Fish Landed by Net and Line Boats and by Steam Beam Trawl Boats—*continued*.

| Date. | District. | Herring. | Sprat. | Sparling. | Mackerel. | Cod. | Ling. | Torsk (Tusk). | Saithe (Coalfish). | Haddock. | Whiting. | Turbot. | Halibut. | Sole (Lemon Sole). | Flounder, Plaice, Brill. | Eel. | Skate. | Other kinds of White Fish. | Oysters. | Mussels. | Clams. | Lobsters. | Crabs. | Other kinds of Shell Fish. | Total Value. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Leith District**—*continued*. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | 100s | cwt. | cwt. | 100s. | 100s. | cwt. | £ |
| 1891 June | I. Net and line boats, | 627 | - | - | - | 3407 | 763 | - | 1306 | 1926 | 601 | 12 | 36 | 2 | 198 | - | 1051 | 582 | - | 981 | 444 | 16·54 | 1037·1 | 142 | 6196 |
| | II. Steam beam trawlers, | - | - | - | - | 1479 | 85 | - | 122 | 3342 | 432 | 98 | - | 474 | 778 | - | 292 | 1057 | - | - | - | - | - | 105 | 4871 |
| | Total, | 627 | - | - | - | 4886 | 848 | - | 1428 | 5268 | 1033 | 110 | 36 | 476 | 976 | - | 1343 | 1639 | - | 981 | 444 | 16·54 | 1037·1 | 247 | 11,067 |
| July | I. Net and line boats, | 217 | - | - | - | 615 | 36 | - | 21 | 1478 | 386 | 12 | 21 | 3 | 357 | - | 68 | 330 | - | 918 | 266 | 6·64 | 488·3 | 186 | 2616 |
| | II. Steam beam trawlers, | - | - | - | - | 975 | 40 | - | 14 | 3676 | 224 | 76 | - | 403 | 852 | - | 323 | 889 | - | - | - | - | - | 80 | 4239 |
| | Total, | 217 | - | - | - | 1590 | 76 | - | 35 | 5154 | 610 | 88 | 21 | 406 | 1209 | - | 391 | 1219 | - | 918 | 266 | 6·64 | 488·3 | 266 | 6855 |
| August | I. Net and line boats, | 1474 | - | - | - | 334 | 8 | - | - | 1021 | 287 | 1 | 2 | 1 | 274 | 14 | 62 | 420 | - | 905 | 273 | 1·73 | 92 | 223 | 2205 |
| | II. Steam beam trawlers, | - | - | - | - | 894 | 30 | - | 8 | 4103 | 259 | 71 | - | 293 | 745 | - | 163 | 883 | - | - | - | - | - | 112 | 4605 |
| | Total, | 1474 | - | - | - | 1228 | 38 | - | 8 | 5124 | 546 | 72 | 2 | 294 | 1019 | 14 | 225 | 1303 | - | 905 | 273 | 1·73 | 92 | 335 | 6810 |
| Sept. | I. Net and line boats, | 2049 | - | 1½ | 18 | 258 | 4 | - | 6 | 842 | 176 | 1 | - | 1 | 231 | 19 | 24 | 245 | - | 10,821 | 350 | 7·68 | 69·6 | 306 | 2656 |
| | II. Steam beam trawlers, | - | - | - | - | 849 | 37 | - | 9 | 4373 | 436 | 41 | - | 253 | 734 | 2 | 178 | 830 | - | - | - | - | - | - | 4370 |
| | Total, | 2049 | - | 1½ | 18 | 1107 | 41 | - | 15 | 5215 | 612 | 42 | - | 254 | 965 | 21 | 202 | 1075 | - | 10,821 | 350 | 7·68 | 69·6 | 306 | 7026 |
| Oct. | I. Net and line boats, | - | - | 1¾ | - | 980 | 20 | - | 17 | 2373 | 815 | 4½ | - | 1 | 731 | 15 | 17 | 413 | 6 | 2673 | 1382 | 6·18 | 648· | 221 | 4085 |
| | II. Steam beam trawlers, | - | - | - | - | 680 | 34 | - | 15 | 3889 | 625 | 33 | - | 188 | 613 | - | 344 | 1444 | - | - | - | - | - | 110 | 4613 |
| | Total, | - | - | 1¾ | - | 1660 | 54 | - | 32 | 6262 | 1440 | 37½ | - | 189 | 1344 | 15 | 361 | 1857 | 6 | 2673 | 1382 | 6·18 | 648· | 331 | 8698 |

TABLE E.—SHOWING FISH LANDED BY NET AND LINE BOATS AND BY STEAM BEAM TRAWL BOATS—*continued*.

| Date. | District. | Herring. | Sprat. | Sparling. | Mackerel. | Cod. | Ling. | (Torsk Tusk). | Saithe (Coalfish). | Haddock. | Whiting. | Turbot. | Halibut. | Sole (Lemon Sole). | Flounder, Plaice, Brill. | Eel. | Skate. | Other kinds of White Fish. | Oysters. | Mussels. | Clams. | Lobsters. | Crabs. | Other kinds of Shell Fish. | Total Value. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Leith District**—*continued*. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | c w. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | 100s | cwt. | cwt. | 100s. | 100s. | cw. | £ |
| 1891 Nov. | I. Net and line boats, . | 14 | – | 1½ | – | 3015 | 163 | – | 21 | 3281 | 532 | 3 | – | 3 | 203 | 61 | 301 | 597 | 6 | 5016 | 5221 | 4·87 | 840· | 117 | 5991 |
| | II. Steam beam trawlers, | – | – | – | – | 1155 | 49 | – | 11 | 6201 | 1167 | 56 | – | 217 | 559 | 16 | 551 | 1442 | – | – | – | – | – | - | 5267 |
| | Total, . | 14 | – | 1½ | – | 4170 | 212 | . | 32 | 9482 | 1699 | 59 | – | 220 | 762 | 77 | 852 | 2039 | 6 | 5016 | 5221 | 4·87 | 840· | 117 | 11,258 |
| Dec. | I. Net and line boats, . | 1447 | 574 | ½ | – | 2703 | 61 | – | 55 | 2368 | 298 | 2 | – | 4 | 393 | 47 | 403 | 707 | 28 | 6365 | 3090 | ·40 | 694· | 171 | 6,184 |
| | II. Steam beam trawlers, | – | – | – | – | 2052 | 30 | – | 11 | 3111 | 501 | 53¾ | – | 137 | 365 | 3½ | 194 | 1030 | – | – | – | – | – | – | 4,718 |
| | Total, . | 1447 | 574 | ½ | – | 4755 | 91 | – | 66 | 5479 | 799 | 55¾ | – | 141 | 758 | 50½ | 597 | 1737 | 28 | 6365 | 3090 | ·40 | 694· | 171 | 10,902 |
| Whole year. | I. Net and line boats, . | 21,368 | 707 | 33½ | 18 | 34,676 | 2666 | 1 | 3131 | 31,579 | 5536 | 97 | 284 | 30 | 3642 | 241½ | 3114 | 8969 | 244 | 38,395 | 27,217 | 58·15 | 7791· | 2173 | 70,634 |
| | II. Steam beam trawlers, | – | – | – | – | 17,712 | 588 | – | 349 | 42,953 | 6227 | 843 | 9 | 2810 | 7437 | 38½ | 3663 | 13,323 | – | – | – | – | – | 614 | 52,451 |
| | Total, . | 21,368 | 707 | 33½ | 18 | 52,388 | 3254 | 1 | 3480 | 74,532 | 11,763 | 940 | 293 | 2840 | 11,079 | 280 | 6777 | 22,292 | 244 | 38,395 | 27,217 | 58·15 | 7791· | 2787 | 123,085 |

TABLE E.—SHOWING FISH LANDED BY NET AND LINE BOATS AND BY STEAM BEAM TRAWL BOATS—*continued.*

| Date | District. | Herring. | Sprat. | Sparling. | Mackerel. | Cod. | Ling. | Torsk (Tusk). | Saithe (Coalfish). | Haddock. | Whiting. | Turbot. | Halibut. | Sole (Lemon Sole). | Flounder, Plaice, Brill. | Eel. | Skate. | Other kinds of White Fish. | Oysters. | Mussels. | Clams. | Lobsters. | Crabs. | Other kinds of Shell Fish. | Total Value. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Anstruther District.** | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt | cwt. | cwt. | cwt. | 100s | cwt. | cwt. | 100s. | 100s. | cwt. | £ |
| 1891 January | By net and line boats, | 9842 | - | 57 | - | 3560 | 51 | - | 179 | 2887 | 376 | - | 1 | - | 80 | 12 | 20 | - | - | 1376 | 160 | - | - | 40 | 10,250 |
| February | ,, ,, | 16,281 | - | 21½ | - | 3711 | 194 | - | 142 | 2846 | 269 | 1 | 6 | - | 1003 | 9 | 62 | - | - | 3288 | 90 | 0·40 | - | 73 | 6298 |
| March | ,, ,, | 1645 | - | - | - | 3106 | 152 | - | 45 | 1177 | 196 | 2 | 5 | - | 335 | - | 196 | - | - | 2686 | 215 | 4·40 | 409·00 | 80 | 3828 |
| April | ,, ,, | 101 | - | - | - | 5719 | 635 | 2 | 319 | 2447 | 179 | 15 | 50 | - | 80 | - | 344 | - | - | 3737 | 330 | 11·30 | 1129·25 | 160 | 4307 |
| May | ,, ,, | 328 | - | - | - | 14,317 | 1010 | 5 | 1554 | 2924 | 234 | 28 | 185 | - | 80 | 2 | 545 | 30 | - | 5020 | - | 14·00 | 3547·00 | 140 | 8465 |
| June | ,, ,, | 27 | - | - | - | 6235 | 600 | - | 1814 | 1868 | 430 | 13 | 62 | - | 188 | 2 | 428 | 54 | - | 3581 | - | 8·00 | 2196·00 | 80 | 4802 |
| July | ,, ,, | 206 | - | - | - | 387 | - | - | - | 1694 | 307 | - | - | - | 236 | - | - | 35 | - | 3131 | - | 48·88 | 671·00 | 40 | 2160 |
| August | ,, ,, | 8423 | - | - | - | 168 | - | - | - | 809 | 230 | - | - | - | 248 | - | - | - | - | 2134 | - | 5·40 | 183·50 | 34 | 3723 |
| September | ,, ,, | 777 | - | 2¾ | 18 | 118 | - | - | - | 1360 | 196 | 3 | - | - | 288½ | 3 | - | - | - | 10,920 | 45 | 17·70 | 11·50 | 62 | 2422 |
| October | ,, ,, | - | - | 60 | - | 477 | 81 | - | - | 1714 | 150 | - | - | - | 279 | 54 | - | - | - | 4905 | 175 | 36·80 | - | 70 | 2585 |
| November | ,, ,, | - | - | 13 | - | 946 | 2 | - | - | 1581 | 178 | - | - | - | 147 | 28 | - | - | - | 2893 | 185 | 22·00 | 6·00 | 110 | 1796 |
| December | ,, ,, | - | - | 17 | - | 2506 | 42 | - | 8 | 1929 | 76 | - | - | - | 55½ | 64 | 31 | - | - | 5136 | 95 | 11·80 | 2·00 | 108 | 3835 |
| Whole year | ,, ,, | 37,630 | - | 171¼ | 18 | 41,250 | 2717 | 7 | 3561 | 23,236 | 2821 | 62 | 309 | - | 3020 | 174 | 1626 | 119 | - | 48,807 | 1295 | 180·68 | 8155·25 | 997 | 53,971 |

TABLE E.—SHOWING FISH LANDED BY NET AND LINE BOATS AND BY STEAM BEAM TRAWL BOATS—*continued.*

| Date. | District. | Herring. | Sprat. | Sparling. | Mackerel. | Cod. | Ling. | Torsk (Tusk). | Saithe (Coalfish). | Haddock. | Whiting. | Turbot. | Halibut. | Sole (Lemon Sole) | Flounder, Plaice, Brill | Eel. | Skate. | Other kinds of White Fish. | Oysters. | Mussels. | Clams. | Lobsters. | Crabs. | Other kinds of Shell Fish. | Total Value. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | wt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | 100s | cwt. | cwt. | 100s. | 100s. | cwt. | £ |
| 1891 | **Montrose District—** | | | | | | | | | | | | | | | | | | | | | | | | |
| Jan. | I. Net and line boats, | 1389½ | 301 | ¼ | - | 687 | 14 | - | 8 | 16,907 | 244 | 1½ | - | - | 187 | 12½ | 14 | 1334 | - | 9922 | - | ·20 | - | 479 | 9553 |
| | II. Steam beam trawlers, | - | - | - | - | 112 | 12 | - | - | 387 | 29 | 8½ | ½ | 26 | 368 | 1 | 26 | 128 | - | - | - | - | - | - | 697 |
| | Total, | 1389½ | 301 | ¼ | - | 799 | 26 | - | 8 | 17,294 | 273 | 10 | ½ | 26 | 505 | 13½ | 40 | 1462 | - | 9922 | - | ·20 | - | 497 | 10,250 |
| Feb. | I. Net and line boats, | 315 | 56 | - | - | 970 | 32 | - | 28 | 17,377 | 560 | 2 | 1 | 8½ | 1173 | 4 | 14 | 1821 | - | 10,110 | - | 1·80 | - | 304 | 8885 |
| | II. Steam beam trawlers, | - | - | - | - | 120 | 11 | - | - | 750 | 18 | 4½ | - | 43½ | 380 | - | 19 | 91 | - | - | - | - | - | - | 700 |
| | Total, | 315 | 56 | - | - | 1090 | 43 | - | 28 | 18,127 | 578 | 6½ | 1 | 52 | 1553 | 4 | 33 | 1912 | - | 10,110 | - | 1·80 | - | 304 | 9585 |
| March | I. Net and line boats, | 5 | - | - | - | 589 | 12 | - | 10 | 3244 | 220 | - | - | 8 | 620 | 3 | 8 | 1351 | - | 3025 | - | 3·35 | 23· | 350 | 3704 |
| | II. Steam beam trawlers, | - | - | - | - | 222 | 4 | - | - | 535 | 44 | 2¼ | ½ | 34 | 125 | - | 18 | 123 | - | - | - | - | - | - | 742 |
| | Total, | 5 | - | - | - | 811 | 16 | - | 10 | 3779 | 264 | 2¼ | ½ | 42 | 745 | 3 | 21 | 1474 | - | 3025 | - | 3·35 | 23· | 350 | 4446 |
| April | I. Net and line boats, | 4 | - | - | - | 2653 | 105 | - | 186 | 7096 | 483 | - | 13 | 10 | 271 | - | 59 | 974 | - | 3527 | - | 19·25 | 76·5 | 447 | 4830 |
| | II. Steam beam trawlers, | - | - | - | - | 111 | 7 | - | 4 | 347 | 41 | 16¼ | 1½ | 92 | 170 | - | 22 | 129 | - | - | - | - | - | - | 542 |
| | Total, | 4 | - | - | - | 2764 | 112 | - | 190 | 7443 | 524 | 16¼ | 14½ | 102 | 441 | - | 81 | 1103 | - | 3527 | - | 19·25 | 76·5 | 447 | 5372 |
| May | I. Net and line boats, | 24 | - | - | - | 4270 | 177 | - | 620 | 6255 | 449 | 2¾ | 27 | 6 | 211 | 2 | 174 | 1021 | - | 3517 | - | 25·50 | 1561· | 277 | 6471 |
| | II. Steam beam trawlers, | - | - | - | - | 105 | 7 | - | 6 | 315 | 47 | 21 | 2 | 82 | 189 | - | 34 | 214 | - | - | - | - | - | - | 593 |
| | Total, | 24 | - | - | - | 4375 | 184 | - | 626 | 6570 | 496 | 23¾ | 29 | 88 | 400 | 2 | 208 | 1235 | - | 3517 | - | 25·50 | 1561· | 277 | 7064 |

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TABLE E.—SHOWING FISH LANDED BY NET AND LINE BOATS AND BY STEAM BEAM TRAWL BOATS—*continued*.

| Date. | District. | Herring. | Sprat. | Sparling. | Mackerel. | Cod. | Ling. | Torsk (Tusk). | Saithe (Coalfish). | Haddock. | Whiting. | Turbot. | Halibut. | Sole (Lemon Sole). | Flounder, Plaice, Brill. | Eel. | Skate. | Other kinds of White Fish. | Oysters. | Mussels. | Clams. | Lobsters. | Crabs. | Other kinds of Shell Fish. | Total Value. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | 100s | cwt. | cwt. | 100s. | 100s. | cwt. | £ |
| | **Montrose District**—*continued.* | | | | | | | | | | | | | | | | | | | | | | | | |
| 1891 June | I. Net and line boats, | 11 | – | – | – | 1525 | 39 | – | 126 | 5762 | 401 | – | – | 4 | 153 | 4 | 32 | 994 | – | 3043 | – | 17·25 | 855· | 263 | 4583 |
| | II. Steam beam trawlers, | – | – | – | – | 117 | 12 | – | – | 636 | 31 | 10 | 1 | 198 | 216 | – | 36 | 315 | – | – | – | – | – | – | 861 |
| | Total, | 11 | – | – | – | 1642 | 51 | – | 126 | 6398 | 432 | 10 | 1 | 202 | 369 | 4 | 68 | 1309 | – | 3043 | – | 17·25 | 855· | 263 | 5444 |
| July | I. Net and line boats, | 9040 | – | – | – | 202 | 6 | – | 22 | 1562 | 242 | ½ | – | 1 | 48 | – | 5 | 373 | – | 1057 | – | 4·75 | 118· | 71 | 3329 |
| | II. Steam beam trawlers, | – | – | – | – | 151 | 11 | – | 6 | 1027 | 172 | 16 | 2 | 171 | 329 | 1 | 48 | 333 | – | – | – | – | – | – | 1343 |
| | Total, | 9040 | – | – | – | 353 | 17 | – | 28 | 2589 | 414 | 16½ | 2 | 172 | 377 | 1 | 53 | 706 | – | 1057 | – | 4·75 | 118· | 71 | 4672 |
| August | I. Net and line boats, | 74,740 | – | – | 2 | 74 | – | – | 4 | 1042 | 185 | – | – | 1 | 13 | – | 5 | 315 | – | 735 | – | 6· | 71· | 50 | 22,379 |
| | II. Steam beam trawlers, | – | – | – | – | 374 | 5 | – | 13 | 2863 | 138 | 34½ | 1¼ | 126 | 415 | – | 103 | 417 | – | – | – | – | – | – | 2255 |
| | Total, | 74,740 | – | – | 2 | 448 | 5 | – | 17 | 3905 | 323 | 34½ | 1¼ | 127 | 428 | – | 108 | 732 | – | 735 | – | 6· | 71· | 50 | 24,634 |
| Sept. | I. Net and line boats, | – | – | – | 130 | 314 | – | – | 4 | 3289 | 244 | – | – | 1 | 138 | – | – | 301 | – | 5703 | – | 6·75 | 4·5 | 125 | 3294 |
| | II. Steam beam trawlers, | – | – | ¾ | – | 138 | 2 | – | 11 | 1143 | 20 | 15 | – | 79 | 483 | 1 | 36 | 281 | – | – | – | – | – | – | 1260 |
| | Total, | – | – | ¾ | 130 | 452 | 2 | – | 15 | 4432 | 264 | 15 | – | 80 | 621 | 1 | 36 | 582 | – | 5703 | – | 6·75 | 4·5 | 125 | 4554 |
| Oct. | I. Net and line boats, | – | – | ½ | – | 221 | 7 | – | 19 | 4484 | 392 | 1 | – | 1 | 433 | – | 4 | 775 | – | 2759 | – | 4·5 | 4·5 | 93 | 3854 |
| | II. Steam beam trawlers, | – | – | – | – | 190 | 10 | – | 19 | 798 | 28 | 26 | – | 55 | 413 | – | 46 | 356 | – | – | – | – | – | – | 1366 |
| | Total, | – | – | ½ | – | 411 | 17 | – | 38 | 5282 | 420 | 27 | – | 56 | 846 | – | 50 | 1131 | – | 2759 | – | 4·5 | 4·5 | 93 | 5220 |

TABLE E.—Showing Fish Landed by Net and Line Boats and by Steam Beam Trawl Boats—*continued.*

| Date. | District. | Herring. | Sprat. | Sparling. | Mackerel. | Cod. | Ling. | Torsk (Tusk). | Saithe (Coalfish). | Haddock | Whiting. | Turbot. | Halibut. | Sole (Lemon Sole). | Flounder, Plaice, Brill. | Eel. | Skate. | Other kinds of White Fish. | Oysters. | Mussels. | Clams. | Lobsters. | Crabs. | Other kinds of Shell Fish. | Total Value. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | 100s | cwt. | cwt. | 100s. | 100s. | cwt. | £ |
| | **Montrose District**—*continued.* | | | | | | | | | | | | | | | | | | | | | | | | |
| 1891 Nov. | I. Net and line boats, | 1202 | 2409 | – | – | 428 | 7 | – | 4 | 4327 | 244 | – | – | – | 228 | 6 | 8 | 1343 | – | 1610 | – | 2·5 | 4· | 78 | 4289 |
| | II. Steam beam trawlers, | – | – | – | – | 140 | 8 | – | 4 | 653 | 22 | 25 | 1 | 40 | 315 | – | 57 | 152 | – | – | – | – | – | – | 918 |
| | Total, | 1202 | 2409 | – | – | 568 | 15 | – | 8 | 4980 | 266 | 25 | 1 | 40 | 538 | 6 | 65 | 1495 | – | 1610 | – | 2·5 | 4· | 78 | 5207 |
| Dec. | I. Net and line boats, | 1231½ | 140 | – | – | 1146 | 15 | – | 10 | 2212 | 90 | – | 1 | 1 | 84 | 12 | 7 | 1352 | – | 3956 | – | 0·5 | – | 36 | 3458 |
| | II. Steam beam trawlers, | – | – | – | – | 79 | 8 | – | 3 | 294 | 12 | 18 | 1 | 32 | 252 | – | 14 | 226 | – | – | – | – | – | – | 856 |
| | Total, | 1231½ | 140 | – | – | 1225 | 23 | – | 13 | 2506 | 102 | 18 | 2 | 33 | 336 | 12 | 21 | 1578 | – | 3956 | – | 0·5 | – | 36 | 4314 |
| Whole year. | I. Net and line boats, | 87,962 | 2906 | ¾ | 132 | 13,079 | 414 | – | 1041 | 73,557 | 3754 | 7¾ | 42 | 41½ | 3504 | 48½ | 380 | 11,954 | – | 48,964 | – | 92·35 | 2717·5 | 2591 | 78,629 |
| | II. Steam beam trawlers, | – | – | ¾ | – | 1859 | 97 | – | 66 | 9748 | 602 | 197 | 10¼ | 978½ | 3655 | 8 | 454 | 2765 | – | – | – | – | – | – | 12,133 |
| | Total, | 87,962 | 2906 | 1½ | 132 | 14,938 | 511 | – | 1107 | 83,305 | 4356 | 204¾ | 52¼ | 1020 | 7159 | 46½ | 784 | 14,719 | – | 48,964 | – | 92·35 | 2717·5 | 2591 | 90,762 |

TABLE E.—SHOWING FISH LANDED BY NET AND LINE BOATS AND BY STEAM BEAM TRAWL BOATS—*continued.*

| Date. | District. | Herring. | Sprat. | Sparling. | Mackerel. | Cod. | Ling. | Torsk (Tusk). | Saithe (Coalfish). | Haddock. | Whiting. | Turbot. | Halibut. | Sole (Lemon Sole). | Flounder, Plaice, Brill. | Eel. | Skate. | Other kinds of White Fish. | Oysters. | Mussels. | Clams. | Lobsters. | Crabs. | Other kinds of Shell Fish. | Total Value. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Stonehaven District**— | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | 100s | cwt. | cwt. | 100s. | 100s. | cwt. | £ |
| 1891 January | By net and line boats, | 17 | – | – | – | 876 | – | – | 4 | 7187 | 449 | 1 | – | – | 18 | 1 | 2 | 8 | – | – | – | – | – | 65 | 3442 |
| February | ,, ,, | 42 | – | – | – | 908 | 4 | – | 9 | 6646 | 423 | 1 | 2 | – | 27 | 3 | – | 4 | – | – | – | – | – | 55 | 2481 |
| March | ,, ,, | – | – | – | – | 574 | – | – | 2 | 774 | 180 | – | – | – | 10 | – | – | 2 | – | – | – | ·30 | 12·60 | 44 | 704 |
| April | ,, ,, | 70 | – | – | – | 2455 | 184 | – | 169 | 1952 | 430 | 3 | 90 | – | 8 | – | 187 | 15 | – | – | – | 1·32 | 119· | 103 | 1965 |
| May | ,, ,, | 42 | – | – | – | 1536 | 52 | – | 155 | 1485 | 323 | 3 | 18 | – | 10 | – | 91 | 15 | | – | – | 4·67 | 778· | 25 | 1870 |
| June | ,, ,, | 49 | – | – | – | 725 | 64 | – | 177 | 2639 | 599 | 2 | 10 | – | 8 | 6 | 100 | 24 | – | – | – | 6·35 | 289·50 | 20 | 1763 |
| July | ,, ,, | 7,750 | – | – | – | 92 | – | – | – | 794 | 461 | – | – | – | 6 | – | – | 24 | – | – | – | 2·56 | 105· | 10 | 2231 |
| August | ,, ,, | 23,190 | – | – | – | 51 | – | – | – | 573 | 661 | – | – | – | 15 | – | – | 41 | – | – | – | 1·23 | 116·65 | 5 | 6929 |
| September | ,, ,, | 112 | – | – | – | 219 | – | – | – | 1565 | 667 | – | – | – | 50 | – | – | 37 | – | – | – | ·35 | 50·75 | 25 | 1327 |
| October | ,, ,, | – | – | – | – | 693 | – | – | – | 2264 | 784 | – | – | – | 38 | – | – | 29 | – | – | – | – | 7· | 80 | 1984 |
| November | ,, ,, | – | – | – | – | 584 | – | – | – | 2070 | 542 | – | – | – | 18 | 6 | – | 13 | – | – | – | – | – | 44 | 1524 |
| December | ,, ,, | – | – | – | – | 622 | 7 | – | – | 1523 | 122 | 1 | – | – | 10 | 5 | 2 | 13 | – | – | – | – | – | 22 | 1443 |
| Whole year | ,, ,, | 31,272 | – | – | – | 9,285 | 311 | – | 516 | 29,472 | 5641 | 11 | 120 | – | 213 | 21 | 382 | 225 | – | – | – | 16·78 | 1478·50 | 498 | 27,683 |

TABLE E.—SHOWING FISH LANDED BY NET AND LINE BOATS AND BY STEAM BEAM TRAWL BOATS—*continued.*

| Date. | District. | Herring. | Sprat. | Sparling. | Mackerel. | Cod. | Ling. | Torsk. (Tusk). | Saithe (Coalfish). | Haddock. | Whiting. | Turbot. | Halibut. | Sole (Lemon Sole). | Flounder, Plaice, Brill. | Eel. | Skate. | Other kinds of White Fish. | Oysters. | Mussels. | Clams. | Lobsters. | Crabs. | Other kinds of Shell Fish. | Total Value. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | 100s | cwt. | cwt. | 100s | 100s. | cwt. | £ |
| 1891 | **Aberdeen District.** | | | | | | | | | | | | | | | | | | | | | | | | |
| Jan. | I. Net and line boats, | 33 | – | – | – | 2511 | 235 | – | 12 | 7718 | 1533 | – | 4 | – | – | 15 | 247 | 680 | – | – | – | – | – | – | 6966 |
| | II. Steam beam trawlers, | – | – | – | – | 811 | 82 | – | 17 | 5257 | 210 | 166 | 2 | 633 | 3666 | 4 | 452 | 2482 | – | – | – | – | – | – | 10449 |
| | Total, | 33 | – | – | – | 3322 | 317 | – | 29 | 12,970 | 1743 | 166 | 6 | 633 | 3666 | 19 | 699 | 3162 | – | – | – | – | – | – | 17,415 |
| Feb. | I. Net and line boats, | 36 | – | – | – | 2515 | 581 | 16 | 43 | 9332 | 1483 | – | 91 | 1 | – | 9 | 429 | 645 | – | – | – | – | – | – | 6820 |
| | II. Steam beam trawlers, | – | – | – | – | 1033 | 108 | – | – | 9110 | 155 | 247 | 3 | 756 | 5646 | – | 522 | 2258 | – | – | – | – | – | – | 12,320 |
| | Total, | 36 | – | – | – | 3548 | 689 | 16 | 43 | 18,442 | 1638 | 247 | 94 | 757 | 5646 | 9 | 951 | 2903 | – | – | – | – | – | – | 19,140 |
| March | I. Net and line boats, | – | – | – | – | 1036 | 124 | – | 6 | 1620 | 389 | – | 19 | – | ½ | 3 | 113 | 147 | – | – | – | – | – | – | 2586 |
| | II. Steam beam trawlers, | – | – | – | – | 2546 | 36 | – | – | 15,182 | 73 | 91 | – | 413 | 1808 | – | 455 | 1410 | – | – | – | – | – | – | 16,640 |
| | Total, | – | – | – | – | 3582 | 160 | – | 6 | 16,802 | 462 | 91 | 19 | 413 | 1808½ | 3 | 568 | 1557 | – | – | – | – | – | – | 19,226 |
| April | I. Net and line boats, | 280 | – | – | – | 5257 | 1267 | 39 | 416 | 4253 | 1006 | – | 477 | – | 15 | – | 619 | 398 | – | – | – | – | – | – | 6363 |
| | II. Steam beam trawlers, | – | – | – | – | 1441 | 114 | – | 49 | 6042 | 67 | 277 | 4 | 1539½ | 2487½ | – | 375 | 2373 | – | – | – | – | – | – | 12,046 |
| | Total, | 280 | – | – | – | 6698 | 1381 | 39 | 465 | 10,295 | 1073 | 277 | 481 | 1539½ | 2502½ | - | 994 | 2771 | – | – | – | – | – | – | 18,409 |
| May | I. Net and line boats, | 385 | – | – | – | 6,601 | 761 | 26 | 1490 | 4671 | 1681 | 6 | 582 | – | 17 | – | 790 | 303 | – | – | – | 2· | 31· | – | 7426 |
| | II. Steam beam trawlers, | – | – | – | – | 800 | 65 | – | 54 | 7298 | 12 | 213 | – | 1707 | 2009 | 4 | 377 | 2318 | – | – | – | – | – | – | 10,920 |
| | Total, | 385 | – | – | – | 7,401 | 826 | 26 | 1544 | 11,969 | 1693 | 219 | 582 | 1707 | 2026 | 4 | 1167 | 2621 | – | – | – | 2· | 31· | – | 18,346 |

TABLE E.—Showing Fish Landed by Net and Line Boats and by Steam Beam Trawl Boats—*continued.*

| Date. | District. | Herring. | Sprat. | Sparling. | Mackerel. | Cod. | Ling. | Torsk (Tusk). | Saithe (Coalfish). | Haddock. | Whiting. | Turbot. | Halibut. | Sole (Lemon Sole). | Flounder, Plaice, Brill. | Eel. | Skate. | Other kinds of White Fish. | Oysters. | Mussels. | Clams. | Lobsters. | Crabs. | Other kinds of Shell Fish. | Total Value. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Aberdeen District**—*continued.* | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | 100s | cwt | cwt. | 100s | 100s. | cwt. | £ |
| 1891 June | I. Net and line boats, | 672 | - | - | - | 3961 | 762 | - | 2337 | 4637 | 2270 | 15 | 664 | - | - | 7 | 575 | 80 | - | - | - | 3· | 46·5 | - | 6339 |
| | II. Steam beam trawlers, | - | - | - | - | 896 | 45 | - | 356 | 7603 | 33 | 164 | - | 1666 | 2905 | - | 305 | 1924 | - | - | - | - | - | - | 9650 |
| | Total, | 672 | - | - | - | 4857 | 807 | - | 2693 | 12,240 | 2303 | 179 | 664 | 1666 | 2905 | 7 | 880 | 2004 | - | - | - | 3· | 46·5 | - | 15,989 |
| July | I. Net and line boats, | 72,627 | - | - | - | 232 | 317 | 55 | 5 | 2240 | 1537 | - | 1172 | - | - | - | 53 | - | - | - | - | - | 13·0 | - | 20,595 |
| | II. Steam beam trawlers, | - | - | - | - | 1420 | 16 | - | 328 | 7303 | 18 | 206 | - | 1362 | 2427 | - | 279 | 2178 | - | - | - | - | - | - | 11,023 |
| | Total, | 72,627 | - | - | - | 1652 | 333 | 55 | 333 | 9543 | 1555 | 206 | 1172 | 1363 | 2427 | - | 332 | 2178 | - | - | - | - | 13·0 | - | 31,618 |
| August | I. Net and line boats, | 159,537 | - | - | - | 178 | 247 | - | - | 1553 | 1486 | - | 1069 | - | 61 | - | 36 | - | - | - | - | 0·25 | 40·5 | - | 58,260 |
| | II. Steam beam trawlers, | - | - | - | - | 1058 | 11 | - | 263 | 6958 | - | 240 | - | 1387 | 1982 | - | 195 | 2027 | - | - | - | - | - | - | 12,279 |
| | Total, | 159,537 | - | - | - | 1236 | 258 | - | 263 | 8511 | 1486 | 240 | 1069 | 1387 | 2043 | - | 231 | 2027 | - | - | - | 0·25 | 40·5 | - | 70,539 |
| Sept. | I. Net and line boats, | 23,929 | - | - | - | 117 | 150 | - | - | 1517 | 1425 | - | 308 | - | 69 | - | 12 | - | - | - | - | - | 31·75 | - | 10,095 |
| | II. Steam beam trawlers, | - | - | - | - | 862 | 60 | - | 120 | 8250 | - | 336 | - | 1469 | 2197 | 11 | 45 | 1910 | - | - | - | - | - | - | 14,768 |
| | Total, | 23,929 | - | - | - | 979 | 210 | - | 120 | 9767 | 1425 | 336 | 308 | 1469 | 2266 | 11 | 57 | 1910 | - | - | - | - | 31·75 | - | 24,863 |
| Oct. | I. Net and line boats, | 42 | - | - | - | 1790 | 330 | - | - | 3097 | 3028 | - | 136 | - | 128 | 80 | 453 | 158 | - | - | - | - | 8·50 | - | 6253 |
| | II. Steam beam trawlers, | - | - | - | - | 936 | 102 | - | 64 | 8978 | 72 | 477 | - | 932 | 3019 | - | 161 | 1964 | - | - | - | - | - | - | 16,225 |
| | Total, | 42 | - | - | - | 2726 | 432 | - | 64 | 12,075 | 3100 | 477 | 136 | 932 | 3147 | 80 | 614 | 2122 | - | - | - | - | 8·50 | - | 22,478 |

TABLE E.—Showing Fish Landed by Net and Line Boats and by Steam Beam Trawl Boats—*continued.*

| Date | District. | Herring. | Sprat. | Sparling | Mackerel. | Cod. | Ling. | Torsk (Tusk). | Saithe (Coalfish). | Haddock. | Whiting. | Turbot. | Halibut. | Sole (Lemon Sole). | Flounder, Plaice, Brill. | Eel. | Skate. | Other kinds of White Fish. | Oysters. | Mussels. | Clams. | Lobsters. | Crabs. | Other kinds of Shell Fish. | Total Value. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | 100s | cwt. | cwt. | 100s | 100s. | cwt. | £ |
| | **Aberdeen District—** *continued.* | | | | | | | | | | | | | | | | | | | | | | | | |
| 1890 Nov. | I. Net and line boats, | - | - | - | - | 2594 | 249 | - | 32 | 2384 | 2346 | - | - | - | 19 | 37 | 367 | 316 | - | - | - | - | - | - | 5113 |
| | II. Steam beam trawlers, | - | - | - | - | 845 | 158 | - | 58 | 9787 | 51 | 347 | 4 | 1078 | 4017 | 7 | 314 | 1423 | - | - | - | - | 3·00 | - | 13,700 |
| | Total, | - | - | - | - | 3439 | 407 | - | 90 | 12,171 | 2397 | 347 | 4 | 1078 | 4036 | 44 | 681 | 1739 | - | - | - | - | 3·00 | - | 18,813 |
| Dec. | I. Net and line boats, | - | - | - | - | 3343 | 225 | - | 108 | 2832 | 810 | - | 2 | - | 2 | 35 | 197 | 559 | - | - | - | - | - | - | 6443 |
| | II. Steam beam trawlers, | - | - | - | - | 974 | 191 | - | 50 | 10,066 | 132 | 260 | 1 | 649 | 3567 | 5 | 253 | 1970 | - | - | - | - | - | - | 16,244 |
| | Total, | - | - | - | - | 4317 | 416 | - | 158 | 12,898 | 942 | 260 | 3 | 649 | 3569 | 40 | 450 | 2529 | - | - | - | - | - | - | 22,687 |
| Whole year. | I. Net and line boats, | 257,541 | - | - | - | 30,135 | 5248 | 136 | 4449 | 45,849 | 18,994 | 21 | 4528 | 1 | 311½ | 186 | 3891 | 3286 | - | - | - | 5·25 | 171·25 | - | 143,259 |
| | II. Steam beam trawlers, | - | - | - | - | 13,622 | 988 | - | 1359 | 101,834 | 823 | 3024 | 10 | 18,592¼ | 35,730¼ | 31 | 3933 | 24,237 | - | - | - | - | 3· | - | 156,264 |
| | Total, | 257,541 | - | - | - | 43,757 | 6236 | 136 | 5808 | 147,683 | 19,817 | 3045 | 4538 | 18,593¼ | 36,042 | 217 | 7624 | 27,523 | - | - | - | 5·25 | 174·25 | - | 299,523 |

TABLE F.—SHOWING THE QUANTITIES MONTHLY OF LARGE AND SMALL FISH LANDED IN THE LEITH AND ABERDEEN DISTRICTS BY BEAM TRAWLERS AND LINE FISHERMEN IN 1891.

| Month. | Stations. | Cod (Large). | Cod (Small). | Haddock (Large). | Whiting (Large). | Haddock and Whiting (Small). | Turbot (Large). | Turbot (Small). | Halibut (Large). | Halibut (Small). | Lemon Sole, Flounder, Plaice, Brill (Large). | Lemon Sole, Flounder, Plaice, Brill (Small). | Other kinds of White Fish (Large). | Other kinds of White Fish (Small). |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | LEITH. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. |
| Jan. | I. Beam trawl, . . . | 1406 | 74 | 4040 | 750 | 698 | 144 | 8 | 1 | ... | 892 | 40 | 1584 | 785 |
| | II. Line, extra-territorial, . | 5710 | 302 | 2940 | 302 | 426 | 3 | ... | 3 | ... | 19 | 12 | 973 | 508 |
| | III. Line, territorial, . . | 2664 | 231 | 1598 | 139 | 229 | ... | ... | 8 | ... | 99 | 28 | 262 | 204 |
| Feb. | I. Beam trawl, . . . | 1162 | 63 | 3376 | 317 | 479 | 83 | 6 | 2 | ... | 931 | 60 | 1131 | 758 |
| | II. Line, extra-territorial, . | 1203 | 67 | 1286 | 93 | 185 | 6 | 1 | 4 | ... | 10 | 2 | 721 | 363 |
| | III. Line, territorial, . . | 2371 | 204 | 3634 | 858 | 512 | ... | ... | ... | ... | 294 | 78 | 212 | 154 |
| Mar. | I. Beam trawl, . . | 1326 | 146 | 1645 | 246 | 273 | 18 | 2 | ... | ... | 260 | 28 | 375 | 262 |
| | II. Line, extra-territorial, . | 255 | 27 | 1688 | 104 | 219 | 5 | 1 | 2 | ... | 36 | 4 | 230 | 55 |
| | III. Line, territorial, . . | 1215 | 176 | 634 | 119 | 112 | ... | ... | 1 | ... | 85 | 36 | 182 | 137 |
| Apr. | I. Beam trawl, . . | 3293 | 366 | 1435 | 334 | 329 | 91 | 10 | 2 | ... | 535 | 59 | 858 | 528 |
| | II. Line, extra-territorial, . | 3560 | 371 | 1177 | 170 | 178 | 11 | 1 | 17 | 1 | 4 | ... | 1430 | 763 |
| | III. Line, territorial, . . | 856 | 113 | 1491 | 210 | 260 | ... | ... | ... | ... | 201 | 50 | 131 | 106½ |
| May | I. Beam trawl, . . | 1614 | 178 | 1947 | 216 | 756 | 48 | 5 | 4 | ... | 569 | 62 | 891 | 653 |
| | II. Line, extra-territorial, . | 3680 | 399 | 1312 | 192 | 152 | 30 | 3 | 187 | 7 | 123 | 15 | 2962 | 657 |
| | III. Line, territorial, . . | 503 | 66 | 688 | 146 | 175 | ... | ... | ... | ... | 149 | 25 | 144 | 71 |
| June | I. Beam Trawl, . . | 1331 | 148 | 2507 | 288 | 979 | 88 | 10 | ... | ... | 1124 | 128 | 956 | 600 |
| | II. Line, extra-territorial, . | 2725 | 298 | 833 | 188 | 128 | 11 | 1 | 33 | 3 | 35 | 7 | 2966 | 590 |
| | III. Line, territorial, . . | 828 | 56 | 806 | 309 | 263 | ... | ... | ... | ... | 137 | 21 | 109 | 46 |
| July | I. Beam trawl, . . | 880 | 95 | 2519 | 323 | 1058 | 69 | 7 | ... | ... | 1125 | 130 | 759 | 507 |
| | II. Line, extra-territorial, . | 298 | 33 | 540 | 76 | 54 | 10 | 2 | 20 | 1 | 103 | 10 | 320 | 76 |
| | III. Line, territorial, . . | 238 | 46 | 692 | 156 | 346 | ... | ... | ... | ... | 212 | 35 | 37 | 20 |

TABLE F.—Showing the Quantities Monthly of Large and Small Fish Landed in the Leith and Aberdeen Districts by Beam Trawlers and Line Fishermen in 1891—*continued.*

| Month. | Stations. | Cod (Large). | Cod (Small). | Haddock (Large). | Whiting (Large). | Haddock and Whiting (Small). | Turbot (Large). | Turbot (Small). | Halibut (Large). | Halibut (Small). | Lemon Sole, Flounder, Plaice, Brill (Large). | Lemon Sole, Flounder, Plaice, Brill (Small). | Other kinds of White Fish (Large). | Other kinds of White Fish (Small). |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | LEITH—*continued.* | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. |
| Aug. | I. Beam trawl, | 796 | 98 | 3461 | 222 | 679 | 63 | 8 | ... | ... | 939 | 99 | 614 | 470 |
| | II. Line, extra-territorial, | 6 | 1 | 72 | 10 | 14 | 1 | ... | ... | ... | 30 | 6 | 147 | 62 |
| | III. Line, territorial, | 268 | 59 | 624 | 189 | 399 | ... | ... | 2 | ... | 177 | 52 | 192 | 102 |
| Sept. | I. Beam trawl, | 765 | 84 | 3239 | 220 | 1350 | 39 | 2 | ... | ... | 889 | 98 | 627 | 429 |
| | II. Line, extra-territorial, | 29 | 2 | 279 | 19 | 112 | 1 | ... | ... | ... | 8 | ... | 82 | 68 |
| | III. Line, territorial, | 198 | 29 | 360 | 71 | 177 | ... | ... | ... | ... | 175 | 49 | 101 | 71½ |
| Oct. | I. Beam trawl, | 605 | 75 | 2593 | 420 | 1501 | 31 | 2 | ... | ... | 726 | 75 | 1145 | 692 |
| | II. Line, extra-territorial, | 125 | 13 | 756 | 422 | 180 | 3 | 1 | ... | ... | 213 | 27 | 188 | 61 |
| | III. Line, territorial, | 663 | 179 | 1145 | 277 | 408 | ¼ | ... | ... | ... | 415 | 77 | 174 | 16¾ |
| Nov. | I. Beam trawl, | 1069 | 86 | 5785 | 863 | 720 | 52 | 4 | ... | ... | 709 | 67 | 1310 | 759 |
| | II. Line, extra-territorial, | 1368 | 92 | 2579 | 286 | 296 | 3 | ... | ... | ... | 21 | ... | 535 | 167 |
| | III. Line, territorial, | 1328 | 227 | 477 | 112 | 63 | ... | ... | ... | ... | 139 | 46 | 262 | 179 |
| Dec. | I. Beam trawl, | 1852 | 200 | 2800 | 376 | 436 | 51 | 2¾ | ... | ... | 453 | 49 | 733½ | 535 |
| | II. Line, extra-territorial, | ... | ... | 1423 | 111 | 199 | 2 | ... | ... | ... | 10 | 4 | 541 | 186 |
| | III. Line, territorial, | 2350 | 353 | 701 | 108 | 124 | ... | ... | ... | ... | 215 | 168 | 315 | 231 |
| Total for Year. | Beam trawl, | 16,099 | 1613 | 35,347 | 4575 | 9258 | 777 | 66¾ | 9 | ... | 9152 | 895 | 10,983½ | 6978 |
| | Line, extra-territorial, | 18,959 | 1605 | 14,885 | 1973 | 2143 | 86 | 10 | 266 | 12 | 612 | 87 | 11,095 | 3551 |
| | Line, territorial, | 12,982 | 1736 | 12,850 | 2194 | 3068 | ¼ | ... | 6 | ... | 2298 | 665 | 2112 | 1338¾ |

TABLE F.—Showing the Quantities Monthly of Large and Small Fish Landed in the Leith and Aberdeen Districts by Beam Trawlers and Line Fishermen in 1891—*continued.*

| Month. | Stations. | Cod (Large). | Cod (Small). | Haddock (Large). | Whiting (Large). | Haddock and Whiting (Small). | Turbot (Large). | Turbot (Small). | Halibut (Large). | Halibut (Small). | Lemon Sole, Flounder, Plaice, Brill (Large). | Lemon Sole, Flounder, Plaice, Brill (Small). | Other kinds of White Fish (Large). | Other kinds of White Fish (Small). |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ABERDEEN. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. |
| Jan. | I. Beam trawl, | 811 | 562 | 3833 | 189 | 1445 | ... | ... | ... | ... | 4242 | 57 | ... | ... |
| | II. Line, | 2511 | 680 | 6685 | 877 | 1684 | ... | ... | ... | ... | ... | ... | ... | ... |
| Feb. | I. Beam trawl, | 1033 | 477 | 6954 | 135 | 2176 | ... | ... | ... | ... | 6309 | 98 | ... | ... |
| | II. Line, | 2515 | 645 | 7863 | 929 | 2018 | ... | ... | ... | ... | 1 | ... | ... | ... |
| Mar. | I. Beam trawl, | 2546 | 199 | 11,767 | 73 | 3415 | ... | ... | ... | ... | 2159 | 62 | ... | ... |
| | II. Line, | 1036 | 147 | 847 | 246 | 916 | ... | ... | ... | ... | ½ | ... | ... | ... |
| April | I. Beam trawl, | 1441 | 428 | 3789 | 65 | 2255 | ... | ... | ... | ... | 3810½ | 216¼ | ... | ... |
| | II. Line, | 5257 | 398 | 2305 | 477 | 2477 | ... | ... | ... | ... | ... | 15 | ... | ... |
| May | I. Beam trawl, | 800 | 701 | 4627 | 12 | 2671 | ... | ... | ... | ... | 3619 | 97 | ... | ... |
| | II. Line, | 6601 | 303 | 2369 | 556 | 3427 | ... | ... | ... | ... | ... | 17 | ... | ... |
| June | I. Beam trawl, | 896 | 388 | 4720 | 28 | 2888 | ... | ... | ... | ... | 4398 | 173 | ... | ... |
| | II. Line, | 3961 | 80 | 2106 | 808 | 3993 | ... | ... | ... | ... | ... | ... | ... | ... |
| July | I. Beam trawl, | 1420 | 681 | 4188 | 18 | 3115 | ... | ... | ... | ... | 3747 | 43 | ... | ... |
| | II. Line, | 232 | ... | 1146 | 483 | 2148 | ... | ... | ... | ... | ... | ... | ... | ... |
| Aug. | I. Beam trawl, | 1058 | 607 | 4138 | ... | 2820 | ... | ... | ... | ... | 3365 | 4 | ... | ... |
| | II. Line, | 178 | ... | 802 | 440 | 1797 | ... | ... | ... | ... | ... | 61 | ... | ... |

TABLE F.—SHOWING THE QUANTITIES MONTHLY OF LARGE AND SMALL FISH LANDED IN THE LEITH AND ABERDEEN DISTRICTS BY BEAM TRAWLERS AND LINE FISHERMEN IN 1891—*continued.*

| Month. | Stations. | Cod (Large). | Cod (Small). | Haddock (Large). | Whiting (Large). | Haddock and Whiting (Small). | Turbot (Large). | Turbot (Small). | Halibut (Large). | Halibut (Small). | Lemon Sole, Flounder, Plaice, Brill (Large). | Lemon Sole, Flounder, Plaice, Brill (Small). | Other kinds of White Fish (Large). | Other kinds of White Fish (Small). |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ABERDEEN—*continued.* | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. | cwt. |
| Sept. | I. Beam trawl, | 862 | 490 | 5448 | ... | 2802 | ... | ... | ... | ... | 3666 | ... | ... | ... |
| | II. Line, | 117 | ... | 798 | 629 | 1515 | ... | ... | ... | ... | ... | 69 | ... | ... |
| Oct. | I. Beam trawl, | 936 | 600 | 6232 | ... | 2812 | ... | ... | ... | ... | 3888 | 68 | ... | ... |
| | II. Line, | 1790 | 61 | 1411 | 1598 | 3116 | ... | ... | ... | ... | ... | 128 | ... | ... |
| Nov. | I. Beam trawl, | 845 | 740 | 7293 | 43 | 2503 | ... | ... | ... | ... | 4907 | 188 | ... | ... |
| | II. Line, | 2594 | 241 | 1281 | 1535 | 1914 | ... | ... | ... | ... | ... | 19 | ... | ... |
| Dec. | I. Beam trawl, | 974 | 1048 | 9010 | 86 | 1102 | ... | ... | ... | ... | 4155 | 61 | ... | ... |
| | II. Line, | 3345 | 565 | 1877 | 584 | 1201 | ... | ... | ... | ... | 2 | ... | ... | ... |
| Tl. for Year. | Beam, | 13,622 | 6921 | 71,999 | 649 | 80,004 | ... | ... | ... | ... | 48,260½ | 1062½ | ... | ... |
| | Line, | 30,137 | 3120 | 29,495 | 9162 | 26,206 | ... | ... | ... | ... | 3½ | 309 | ... | ... |

## TABLE G.—Showing the Monthly Takes of Line and Net Boats from Inshore Grounds in the Leith, Anstruther, Montrose, and Stonehaven Districts.

### I. LEITH DISTRICT. North Berwick.

| Month and Number of Days Fishing. | Quantity of Net and Line Fish caught within the Territorial Waters. | | | | | | | | | | | | | | | | | | | | Number of Trips and Size of Boats Fishing. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Herring. | | Cod. | | Haddock. | | Whiting. | | Lemon Soles. | | Turbot and Brill. | | Plaice and Flounders. | | Dabs. | | Skate. | | Other White Fish. | | Within the Territorial Waters. | | Beyond the Territorial Waters. | |
| 1891. | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *No.* | *Size.* | *No.* | *Size.* |
| Jan. (22) | 65½ | 0·72 | 109 | 1·21 | 59½ | 0·66 | 29¼ | 0·32 | ... | ... | ... | ... | 26½ | 0·29 | ... | ... | 15 | 0·16 | ... | ... | 90 | 19 to 23 ft. | ... | ... |
| Feb. (19) | ... | ... | 32 | 0·41 | 44½ | 0·57 | 25 | 0·32 | ... | ... | ... | ... | 11½ | 0·14 | ... | ... | 8½ | 0·108 | ... | ... | 78 | 18 to 23 ft. | ... | ... |
| Mar. (14) | ... | ... | 26 | 0·57 | 35½ | 0·78 | 4½ | 0·1 | ... | ... | ... | ... | 5½ | 0·12 | ... | ... | 6 | 0·13 | ... | ... | 45 | 19 to 23 ft. | ... | ... |
| Apr. (22) | ... | ... | 79½ | 0·43 | 105½ | 0·58 | 62 | 0·34 | ... | ... | ... | ... | 83 | 0·18 | ... | ... | 22 | 0·12 | ... | ... | 181 | 18 to 23 ft. | ... | ... |
| May (25) | ... | ... | 97½ | 0·35 | 194½ | 0·71 | 84 | 0·307 | ... | ... | ... | ... | 53½ | 0·12 | ... | ... | 37½ | 0·13 | ... | ... | 273 | 18 to 23 ft. | 1 | 45 ft. |
| June (26) | 2 | 0·006 | 133 | 0·46 | 186½ | 0·64 | 147½ | 0·51 | ... | ... | ... | ... | 58 | 0·2 | ... | ... | 48 | 0·16 | ... | ... | 289 | 18 to 23 ft. | ... | ... |
| July (26) | ... | ... | 139 | 0·47 | 182 | 0·61 | 124 | 0·43 | ... | ... | ... | ... | 42½ | 0·14 | ... | ... | 35¼ | 0·12 | ... | ... | 295 | 19 to 23 ft. | ... | ... |
| Aug. (24) | ... | ... | 101 | 0·44 | 134½ | 0·58 | 73 | 0·31 | ... | ... | ... | ... | 25½ | 0·11 | ... | ... | 19¼ | 0·08 | ... | ... | 229 | 18 to 23 ft. | ... | ... |
| Sept. (16) | ... | ... | 34 | 0·3 | 61½ | 0·54 | 43½ | 0·38 | ... | ... | ... | ... | 15½ | 0·13 | ... | ... | 9 | 0·07 | ... | ... | 113 | 18 to 23 ft. | ... | ... |
| Oct. (22) | ... | ... | 18 | 0·22 | 32½ | 0·406 | 23 | 0·28 | ... | ... | 18 | 0·22 | 16 | 0·2 | ... | ... | ... | ... | ... | ... | 80 | 20 to 23 ft. | ... | ... |
| Nov. (22) | ... | ... | 21½ | 0·33 | 30 | 0·46 | 20½ | 0·31 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 65 | 20 to 23 ft. | ... | ... |
| Dec. (24) | ... | ... | 78 | 1·27 | 36 | 0·59 | 17½ | 0·28 | ... | ... | ... | ... | 8 | 0·13 | .. | ... | ... | ... | ... | ... | 61 | 20 to 30 ft. | 6 | 30 ft. |
| Total for year | 67½ | 0·037 | 868½ | 0·48 | 1102¼ | 0·61 | 653¾ | 0·36 | ... | ... | 18 | 0·01 | 295½ | 0·16 | ... | ... | 201 | 0·11 | ... | ... | 1799 | | | |

TABLE G.—I. LEITH DISTRICT—*continued*. COCKENZIE AND PORTSETON.

| Month and Number of Days Fishing. | Quantity of Net and Line Fish caught within the Territorial Waters. | | | | | | | | | | | | | | | | | | | Number of Trips and Size of Boats Fishing. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Herring. | | Cod. | | Haddock. | | Whiting. | | Lemon Soles. | | Turbot and Brill. | | Plaice and Flounders. | | Dabs. | | Skate. | | Other White Fish. | | Within the Territorial Waters. | | Beyond the Territorial Waters. |
| | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *No.* | *Size.* | *No.* | *Size.* |
| 1891. Jan. (26) | ... | ... | 1244 | 2·61 | 396 | 0·83 | 37 | 0·07 | ... | ... | ... | ... | 16 | 0·03 | ... | ... | ... | ... | ... | ... | 475 | 81 to 141 ft. | ... | ... |
| Feb. (24) | ... | ... | 709 | 1·59 | 238 | 0·53 | ... | ... | ... | ... | ... | ... | 30 | 0·06 | ... | ... | ... | ... | ... | ... | 445 | 83 to 200 ft. | ... | ... |
| Mar. (22) | ... | ... | 630 | 1·59 | 170 | 0·43 | 35 | 0·08 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 395 | 83 to 143 ft. | ... | ... |
| Apr. (26) | ... | ... | 380 | 1·104 | 224 | 0·65 | 24½ | 0·71 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 344 | 81 to 158 ft. | ... | ... |
| May (26) | ... | ... | 155 | 0·33 | 190½ | 1·02 | 10 | 0·05 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 186 | 82 to 174 ft. | ... | ... |
| June (26) | ... | ... | 38½ | 0·21 | 260 | 1·42 | 54 | 0·29 | ... | ... | ... | ... | 42½ | 0·23 | ... | ... | ... | ... | ... | ... | 182 | 82 to 173 ft. | ... | ... |
| July (25) | ... | ... | 59 | 0·38 | 156 | 0·89 | 24 | 0·13 | ... | ... | ... | ... | 76 | 0·43 | ... | ... | ... | ... | ... | ... | 175 | 82 to 173 ft. | ... | ... |
| Aug. (24) | ... | ... | 86 | 0·56 | 122 | 0·807 | 42½ | 0·28 | ... | ... | ... | ... | 36 | 0·23 | ... | ... | ... | ... | ... | ... | 151 | 81 to 143 ft. | ... | ... |
| Sept. (18) | ... | ... | 72 | 0·52 | 102 | 0·75 | 32 | 0·23 | ... | ... | ... | ... | 25 | 0·18 | ... | ... | ... | ... | ... | ... | 136 | 81 to 141 ft. | ... | ... |
| Oct. (26) | ... | ... | 606 | 1·18 | 202 | 0·39 | 44 | 0·08 | ... | ... | ... | ... | 128 | 0·25 | ... | ... | ... | ... | ... | ... | 511 | 81 to 141 ft. | ... | ... |
| Nov. (26) | ... | ... | 447 | 0·96 | 173 | 0·37 | 99 | 0·21 | ... | ... | ... | ... | 43 | 0·09 | ... | ... | ... | ... | ... | ... | 463 | 81 to 141 ft. | ... | ... |
| Dec. (23) | ... | ... | 213 | 0·52 | 297 | 0·73 | 66 | 0·16 | ... | ... | ... | ... | 19½ | 0·04 | ... | ... | ... | ... | ... | ... | 402 | 81 to 141 ft. | ... | ... |
| Total for year | ... | ... | 4639½ | 1·20 | 2530½ | 0·65 | 468 | 0·12 | ... | ... | ... | ... | 416 | 0·10 | ... | ... | ... | ... | ... | ... | 3865 | | | |

TABLE G.—I. LEITH DISTRICT—*continued.* FISHERROW.

| Month and Number of Days Fishing. | Quantity of Net and Line Fish caught within the Territorial Waters. | | | | | | | | | | | | | | | | | | | | Number of Trips and Size of Boats Fishing. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Herring. | | Cod. | | Haddock. | | Whiting. | | Lemon Soles. | | Turbot and Brill. | | Plaice and Flounders. | | Dabs. | | Skate. | | Other White Fish. | | Within the Territorial Waters. | | Beyond the Territorial Waters. | |
| | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *No.* | *Size.* | *No.* | *Size.* |
| 1891. Jan. (23) | 149 | 1·33 | 507 | 4·52 | 96 | 0·85 | 31 | 0·27 | ... | ... | ... | ... | 23 | 0·205 | ... | ... | 12 | 0·107 | ... | ... | 112 | 22 to 30 ft. | 57 | 44 to 58 ft. |
| Feb. (19) | ... | ... | 114 | 1·38 | 79 | 0·95 | 24 | 0·28 | 222 | 2·67 | ... | ... | ... | | ... | ... | ... | ... | 6 | 0·07 | 83 | 22 to 29 ft. | 62 | 45 to 58 ft. |
| Mar. (17) | ... | ... | 202 | 2·14 | 137 | 1·45 | 62 | 0·65 | 49 | 0·52 | ... | ... | ... | | ... | ... | ... | | 43 | 0·45 | 94 | 22 to 29 ft. | 26 | 44 to 59 ft. |
| Apr. (24) | ... | ... | 237 | 1·73 | 133 | 0·97 | 58 | 0·42 | 48 | 0·35 | ... | ... | ... | ... | ... | | ... | | 57 | 0·41 | 137 | 22 to 40 ft. | 59 | 44 to 58 ft. |
| May (19) | ... | ... | 111 | 0·99 | 123 | 1·09 | 42 | 0·37 | 68 | 0·607 | ... | | ... | | ... | | ... | | 19 | 0·16 | 112 | 22 to 29 ft. | 20 | 44 to 56 ft. |
| June (13) | ... | | 71 | 1·01 | 110 | 1·57 | 51 | 0·72 | 46 | 0·65 | ... | | ... | | ... | | ... | | 6 | 0·08 | 70 | 19 to 27 ft. | 6 | 58 ft. |
| July (14) | ... | | 56 | 1·0 | 100 | 1·78 | 39 | 0·69 | 81 | 1·44 | ... | | ... | | ... | | ... | | ... | | 56 | 22 to 27 ft. | 3 | 44 ft. |
| Aug. (14) | ... | ... | 36 | 0·75 | 44 | 0·91 | 21 | 0·43 | ... | ... | ... | ... | 72 | 1·5 | ... | ... | ... | ... | ... | ... | 48 | 22 to 29 ft. | 1 | 44 ft. |
| Sept. (12) | ... | | 1 | 0·08 | 2 | 0·06 | ... | | ... | | ... | | 79 | 2·63 | ... | | ... | | ... | | 30 | 22 to 27 ft. | 2 | 44 to 52 ft. |
| Oct. (20) | ... | | 63 | 0·807 | 30 | 0·38 | 7 | 0·08 | ... | | ... | | 161 | 2·06 | ... | | ... | | ... | | 78 | 22 to 30 ft. | 22 | 40 to 57 ft. |
| Nov. (21) | ... | | 331 | 3·55 | 113 | 1·21 | 32 | 0·34 | ... | | ... | | 42 | 0·45 | ... | | 3 | 0·03 | ... | | 93 | 24 to 40 ft. | 53 | 44 to 58 ft. |
| Dec. (25) | 52 | 0·55 | 648 | 6·96 | 42 | 0·45 | 10 | 0·10 | ... | | ... | | 24 | 0·25 | ... | | 77 | 0·82 | 22 | 0·23 | 93 | 22 to 47 ft. | 27 | 45 to 58 ft. |
| Total for year | 201 | 0·19 | 2377 | 2·36 | 1009 | 1·00 | 377 | 0·37 | 514 | 0·51 | ... | | 401 | 0·39 | ... | | 92 | 0·09 | 153 | 0·15 | 1006 | | | |

TABLE G.—I. LEITH DISTRICT—*continued*. NEWHAVEN.

| Month and Number of Days Fishing. | Quantity of Net and Line Fish caught within the Territorial Waters. | | | | | | | | | | | | | | | | | | | | Number of Trips and Size of Boats Fishing. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Herring. | | Cod. | | Haddock. | | Whiting. | | Lemon Soles. | | Turbot and Brill. | | Plaice and Flounders. | | Dabs. | | Skate. | | Other White Fish. | | Within the Territorial Waters. | | Beyond the Territorial Waters. | |
| 1891. | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *No.* | *Size.* | *No.* | *Size.* |
| Jan. (25) | 973¾ | 3·24 | 949 | 8·16 | 16½ | 0·05 | 20 | 0·06 | ... | ... | ... | ... | 4 | 0·01 | ... | ... | 111 | 0·87 | 184 | 0·61 | 300 | 25 to 55 ft. | 171 | 48 to 55 ft. |
| Feb. (18) | 612¾ | 5·83 | 701½ | 6·68 | 132 | 1·25 | 12 | 0·11 | ... | ... | ... | ... | 15 | 0·14 | ... | ... | 10 | 0·09 | 115½ | 1·1 | 105 | 25 to 55 ft. | 111 | 48 to 55 ft. |
| Mar. (17) | 101 | 1·29 | 350 | 4·48 | 71 | 0·91 | 8½ | 0·108 | ... | ... | ... | ... | 8½ | 0·108 | ... | ... | 18 | 0·23 | 185 | 1·73 | 78 | 25 to 55 ft. | 24 | 48 to 55 ft. |
| Apr. (22) | 4 | 0·28 | 97 | 0·702 | 117 | 0·84 | 19 | 0·18 | ... | ... | ... | ... | 33 | 0·23 | ... | ... | 19 | 0·13 | 234½ | 1·69 | 138 | 25 to 55 ft. | 103 | 48 to 55 ft. |
| May | No return. | | | | | | | | | | | | | | | | | | | | | | | |
| June | ,, | | | | | | | | | | | | | | | | | | | | | | | |
| July | ,, | | | | | | | | | | | | | | | | | | | | | | | |
| Aug. (20) | ... | ... | 23½ | 0·25 | 39 | 0·42 | 6 | 0·06 | ... | ... | ... | ... | 70½ | 0·77 | ... | ... | ... | ... | ... | ... | 91 | 15 to 25 ft. | 10 | 55 ft. |
| Sept. (14) | ... | ... | 8 | 0·32 | ... | ... | ... | ... | ... | ... | ... | ... | 15 | 0·6 | ... | ... | ... | ... | ... | ... | 25 | 15 to 25 ft. | 29 | 45 to 55 ft. |
| Oct. (22) | ... | ... | 89½ | 1·68 | ... | ... | ... | ... | ... | ... | ... | ... | 22½ | 0·88 | ... | ... | 19 | 0·32 | 6 | 0·101 | 59 | 15 to 55 ft. | 57 | 45 to 55 ft. |
| Nov. (16) | ... | ... | 374 | 4·29 | ... | ... | ... | ... | ... | ... | ... | ... | 8 | 0·09 | ... | ... | 62½ | 0·71 | 48 | 0·55 | 87 | 25 to 55 ft. | 72 | 45 to 55 ft. |
| Dec. (21) | ... | ... | 1997 | 12·48 | ... | ... | ... | ... | ... | ... | ... | ... | 2 | 0·01 | ... | ... | 69½ | 0·43 | 68 | 0·42 | 160 | 25 to 55 ft. | 16 | 45 to 60 ft. |
| Total for year | 1691½ | 1·79 | 4589½ | 0·48 | 375½ | 0·39 | 65½ | 0·06 | ... | ... | ... | ... | 178½ | 0·18 | ... | ... | 309 | 0·32 | 791 | 0·83 | 943 | | | |

## TABLE G.—II. ANSTRUTHER DISTRICT. LARGO.

| Month and Number of Days Fishing. | Quantity of Net and Line Fish caught within the Territorial Waters. | | | | | | | | | | | | | | | | | | | | Number of Trips and Size of Boats Fishing. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Herring. | | Cod. | | Haddock. | | Whiting. | | Lemon Soles. | | Turbot and Brill. | | Plaice and Flounders. | | Dabs. | | Skate. | | Other White Fish. | | Within the Territorial Waters. | | Beyond the Territorial Waters. | |
| 1891. | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *No.* | *Size.* | *No.* | *Size.* |
| Jan. (25) | ... | ... | 136 | 0·64 | 111 | 0·52 | 25 | 0·11 | ... | ... | ... | ... | 28 | 0·13 | .. | ... | ... | ... | ... | ... | 210 | 15 to 25 ft. | ... | ... |
| Feb. (23) | ... | ... | 125 | 0·504 | 22 | 0·08 | 22 | 0·08 | ... | ... | ... | ... | 392 | 1·58 | ... | ... | ... | ... | ... | ... | 248 | 15 to 24 ft. | ... | ... |
| Mar. (20) | ... | ... | 61 | 0·35 | 55 | 0·32 | 16 | 0·09 | ... | ... | ... | ... | 88 | 0·51 | ... | ... | ... | ... | ... | ... | 170 | 15 to 24 ft. | ... | ... |
| Apr. (23) | ... | ... | 80 | 0·57 | 98 | 0·7 | 13 | 0·09 | ... | ... | ... | ... | 16 | 0·11 | ... | ... | ... | ... | ... | ... | 140 | 15 to 24 ft. | ... | ... |
| May (26) | ... | ... | 26 | 0·25 | 113 | 1·107 | 35 | 0·34 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 102 | 18 to 24 ft. | ... | ... |
| June (26) | ... | ... | 26 | 0·24 | 164 | 1·51 | 27 | 0·25 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 108 | 18 to 24 ft. | ... | ... |
| July (27) | ... | ... | ... | ... | 82 | 1·0 | 25 | 0·304 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 82 | 18 to 20 ft. | ... | ... |
| Aug. (26) | ... | ... | 4 | 0·08 | 70 | 1·46 | 5 | 0·104 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 48 | 14 to 18 ft. | ... | ... |
| Sept. (23) | ... | ... | 9 | 0·07 | 66 | 0·55 | ... | ... | ... | ... | ... | ... | 21 | 0·17 | 42 | 0·35 | ... | ... | ... | ... | 118 | 16 to 24 ft. | ... | ... |
| Oct. (25) | ... | ... | 87 | 0·48 | 59 | 0·33 | ... | ... | ... | ... | ... | ... | 50 | 0·28 | 22 | 0·12 | ... | ... | ... | ... | 178 | 16 to 25 ft. | ... | ... |
| Nov. (22) | ... | ... | 87 | 0·57 | 30 | 0·19 | ... | ... | ... | ... | ... | ... | 27 | 0·17 | 16 | 0·105 | ... | ... | ... | ... | 151 | 15 to 25 ft. | ... | ... |
| Dec. (24) | ... | ... | 89 | 0·79 | 20 | 0·17 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 112 | 15 to 24 ft. | ... | ... |
| Total for year. | ... | ... | 728 | 0·43 | 890 | 0·53 | 168 | 0·10 | ... | ... | ... | ... | 622 | 0·37 | 80 | 0·47 | ... | ... | ... | ... | 1667 | | | |

TABLE G.—II. ANSTRUTHER DISTRICT—*continued*. ELIE AND EARLSFERRY.

| Month and Number of Days Fishing. | Quantity of Net and Line Fish caught within the Territorial Waters. | | | | | | | | | | | | | | | | | | | | Number of Trips and Size of Boats Fishing. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Herring. | | Cod. | | Haddock. | | Whiting. | | Lemon Soles. | | Turbot and Brill. | | Plaice and Flounders. | | Dabs. | | Skate. | | Other White Fish. | | Within the Territorial Waters. | | Beyond the Territorial Waters. | |
| 1890. | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *No.* | *Size.* | *No.* | *Size.* |
| Jan. (25) | ... | ... | 41½ | 0·44 | 43¾ | 0·46 | 37¼ | 0·39 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 94 | 14 to 16 ft. | ... | ... |
| Feb. (21) | ... | ... | 32¾ | 0·404 | 38¼ | 0·47 | 20½ | 0·25 | ... | ... | ... | ... | 47½ | 0·58 | ... | ... | ... | ... | ... | ... | 81 | 14 tc 16 ft. | ... | ... |
| Mar. (14) | ... | ... | 21½ | 0·405 | 18¾ | 0·35 | 9 | 0·16 | ... | ... | ... | ... | 30¼ | 0·57 | ... | ... | ... | ... | ... | ... | 53 | 14 to 16 ft. | ... | ... |
| Apr. (21) | ... | ... | 35¾ | 0·42 | 53¾ | 0·63 | 5¼ | 0·06 | ... | ... | ... | ... | ... | ... | 13½ | 0·16 | ... | ... | ... | ... | 84 | 14 to 16 ft. | ... | ... |
| May (26) | ... | ... | 36 | 0·34 | 51½ | 0·49 | 14 | 0·13 | ... | ... | ... | ... | 10¾ | 0·103 | ... | ... | ... | ... | 17 | 0·16 | 104 | 14 to 16 ft. | ... | ... |
| June (26) | ... | ... | 36¼ | 0·36 | 61 | 0·61 | 35¼ | 0·35 | ... | ... | ... | ... | 7½ | 0·75 | ... | ... | ... | ... | 48¾ | 0·48 | 100 | 14 to 16 ft. | ... | ... |
| July (27) | ... | ... | 20¾ | 0·19 | 37½ | 0·34 | 33¾ | 0·31 | ... | ... | ... | ... | ... | ... | 8½ | 0·07 | ... | ... | 29½ | 0·27 | 108 | 14 to 16 ft. | ... | ... |
| Aug. (25) | 49 | 0·49 | 13 | 0·13 | 96¾ | 0·96 | 84¼ | 0·84 | ... | ... | ... | ... | 15¼ | 0·15 | ... | ... | ... | ... | ... | ... | 100 | 14 to 16 ft. | ... | ... |
| Sept. (20) | ... | ... | 6¾ | 0·09 | 23¼ | 0·32 | 22 | 0·305 | ... | ... | ... | ... | 9 | 0·12 | ... | ... | ... | ... | ... | ... | 72 | 14 to 16 ft. | ... | ... |
| Oct. (21) | ... | ... | 10¼ | 0·13 | 24½ | 0·33 | 26¼ | 0·35 | ... | ... | ... | ... | 8¾ | 0·108 | ... | ... | ... | ... | ... | ... | 74 | 14 to 16 ft. | ... | ... |
| Nov. (20) | ... | ... | 8 | 0·101 | 20¼ | 0·25 | 15¾ | 0·19 | ... | ... | ... | ... | 14¼ | 0·18 | ... | ... | ... | ... | ... | ... | 79 | 14 to 16 ft. | ... | ... |
| Dec. (15) | ... | ... | 13¾ | 0·29 | 12½ | 0·26 | 10¼ | 0·22 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 47 | 14 to 16 ft. | ... | ... |
| Total for year. | 49 | 0·04 | 276¼ | 0·27 | 481½ | 0·48 | 313½ | 0·31 | ... | ... | ... | ... | 143¼ | 0·14 | 22 | 0·02 | ... | ... | 95¼ | 0·09 | 996 | | | |

TABLE G.—II. ANSTRUTHER DISTRICT—*continued.* ST. MONANCE.

| Month and Number of Days Fishing. | Quantity of Net and Line Fish caught within the Territorial Waters. | | | | | | | | | | | | | | | | | | | | Number of Trips and Size of Boats Fishing. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Herring. | | Cod. | | Haddock. | | Whiting. | | Lemon Soles. | | Turbot and Brill. | | Plaice and Flounders. | | Dabs. | | Skate. | | Other White Fish. | | Within the Territorial Waters. | | Beyond the Territorial Waters. | |
| 1891. | *Crans.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *No.* | *Size.* | *No.* | *Size.* |
| Jan. (27) | 324 | 0·64 | 1863 | 3.71 | 713 | 1·42 | 91 | 0·18 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 9 | 0·01 | 501 | 25 to 58 ft. | ... | ... |
| Feb. (23) | 225 | 0·69 | 770 | 2·37 | 649 | 2·003 | 72 | 0·22 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 324 | 25 to 58 ft. | 82 | 56 to 58 ft. |
| Mar. (24) | ... | ... | 824 | 2·76 | 375 | 1·25 | 69 | 0·23 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 298 | 25 to 58 ft. | 37 | 48 to 57 ft. |
| Apr. (21) | ... | ... | 79 | 0·34 | 436 | 1·903 | 53 | 0·23 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 229 | 25 to 30 ft. | 42 | 52 to 59 ft. |
| May (26) | ... | ... | 81 | 0·33 | 268 | 1·11 | 56 | 0·23 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 240 | 24 to 28 ft. | 34 | 48 to 56 ft. |
| June (26) | ... | ... | 19 | 0·08 | 278 | 1·29 | 197 | 0·92 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 214 | 22 to 28 ft. | 23 | 46 to 58 ft. |
| July (25) | ... | ... | 34 | 0·28 | 131 | 1·09 | 105 | 0·87 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 120 | 22 to 28 ft. | 1 | 45 ft. |
| Aug. (26) | 54 | 0·43 | 38 | 0·306 | 90 | 0·72 | 53 | 0·42 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 124 | 24 to 46 ft. | 6 | 44 to 46 ft. |
| Sept. (16) | ... | ... | 22 | 0·32 | 46 | 0·67 | 19 | 0·27 | ... | ... | 3 | 0·04 | ... | ... | ... | ... | ... | ... | ... | ... | 68 | 24 to 45 ft. | ... | ... |
| Oct. (23) | ... | ... | 93 | 0·35 | 181 | 0·68 | 39 | 0·14 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 265 | 24 to 48 ft. | ... | ... |
| Nov. (23) | ... | ... | 199 | 0·65 | 218 | 0·72 | 32 | 0·105 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 302 | 24 to 48 ft. | ... | ... |
| Dec. (26) | ... | ... | 374 | 1·12 | 199 | 0·601 | 40 | 0·12 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 331 | 28 to 58 ft. | 6 | 45 to 58 ft. |
| Total for year. | 603 | 0·19 | 4596 | 1·52 | 3584 | 1·18 | 826 | 0·27 | ... | ... | 3 | 0·000 | ... | ... | ... | ... | ... | ... | 9 | 0·002 | 3016 | | | |

TABLE G.—II. ANSTRUTHER DISTRICT—*continued*. PITTENWEEM.

| Month and Number of Days Fishing. | Quantity of Net and Line Fish caught within the Territorial Waters. | | | | | | | | | | | | | | | | | | | | Number of Trips and Size of Boats Fishing. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Herring. | | Cod. | | Haddock. | | Whiting. | | Lemon Soles. | | Turbot and Brill. | | Plaice and Flounders. | | Dabs. | | Skate. | | Other White Fish. | | Within the Territorial Waters. | | Beyond the Territorial Waters. | |
| 1891. | *Crans.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *No.* | *Size.* | *No.* | *Size.* |
| Jan. (20) | ... | ... | 26 | 0·17 | 188 | 1·24 | 26 | 0·17 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 151 | 25 ft. | 13 | 48 to 50 ft. |
| Feb. (18) | ... | ... | 38 | 0·26 | 226 | 1·602 | 35 | 0·24 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 141 | 25 ft. | 9 | 48 ft. |
| Mar. (13) | ... | ... | 26 | 0·27 | 80 | 0·85 | 27 | 0·28 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 94 | 25 ft. | 10 | 48 to 52 ft. |
| Apr. (19) | ... | ... | 41 | 0·25 | 166 | 1·05 | 30 | 0·18 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 158 | 25 ft. | 5 | 48 ft. |
| May (23) | ... | ... | 38 | 0·21 | 183 | 1·02 | 32 | 0·17 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 179 | 25 ft. | 9 | 48 to 54 ft. |
| June (21) | ... | ... | 42 | 0·28 | 206 | 1·41 | 36 | 0·24 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 146 | 25 ft. | 5 | 48 to 52 ft. |
| July (24) | ... | ... | 42 | 0·22 | 213 | 1·16 | 37 | 0·202 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 183 | 25 ft. | ... | ... |
| Aug. (14) | 164 | 1·56 | 17 | 0·16 | 82 | 0·78 | 15 | 0·14 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 105 | 25 ft. | 1 | 52 ft. |
| Sept. (14) | ... | ... | 8 | 0·105 | 74 | 0·97 | 10 | 0·13 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 76 | 25 ft. | ... | ... |
| Oct. (14) | ... | ... | 5 | 0·06 | 48 | 0·64 | 4 | 0·05 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 75 | 25 ft. | 1 | 53 ft. |
| Nov. (15) | ... | ... | 14 | 0·16 | 59 | 0·67 | 3 | 0·03 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 87 | 25 ft. | 26 | 52 to 54 ft. |
| Dec. (13) | ... | ... | 37 | 0·41 | 60 | 0·67 | 6 | 0·06 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | .. | 89 | 25 ft. | 43 | 48 to 53 ft. |
| Total for year | 164 | 0·11 | 334 | 0·22 | 1585 | 1·06 | 261 | 0·17 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 1484 | | | |

TABLE G.—II. ANSTRUTHER DISTRICT—*continued.* ANSTRUTHER.

| Month and Number of Days Fishing. | Quantity of Net and Line Fish caught within the Territorial Waters. | | | | | | | | | | | | | | | | | | | | Number of Trips and Size of Boats Fishing. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Herring. | | Cod. | | Haddock. | | Whiting. | | Lemon Soles. | | Turbot and Brill. | | Plaice and Flounders. | | Dabs. | | Skate. | | Other White Fish. | | Within the Territorial Waters. | | Beyond the Territorial Waters. | |
| 1891. | *Crans.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *No.* | *Size.* | *No.* | *Size.* |
| Jan. (23) | 2177 | 2·23 | 754 | 0·77 | 49⅓ | 0·05 | 4¾ | 0·004 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 117 | 0·12 | 973 | 25 to 58 ft. | 91 | 50 to 58 ft. |
| Feb. (24) | 3978 | 4·09 | 991 | 1·02 | 49 | 0·05 | 2¾ | 0·002 | ... | ... | ... | ... | 7¼ | 0·007 | ... | ... | ... | ... | 52 | 0·05 | 971 | 18 to 57 ft. | 90 | 50 to 57 ft. |
| Mar. (17) | 302 | 1·01 | 31 | 0·104 | 3 | 0·01 | 1 | 0·003 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 298 | 46 to 58 ft. | 134 | 50 to 58 ft. |
| Apr. | | No | fishing | in | territorial | w | aters. | | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 92 | 46 to 58 ft. |
| May | ,, | | ,, | | ,, | | ,, | | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 217 | 46 to 58 ft. |
| June | ,, | | ,, | | ,, | | ,, | | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 120 | 46 to 57 ft. |
| July | ,, | | ,, | | ,, | | ,, | | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 7 | 40 to 53 ft. |
| Aug. (9) | 1283¾ | 16·25 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 79 | 20 to 50 ft. | 72 | 40 to 55 ft. |
| Sept. (5) | 221¾ | 12·31 | ¼ | 0·013 | 1 | 0·5 | ¼ | 0·01 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 18 | 46 to 57 ft. | ... | ... |
| Oct. (11) | ... | ... | 3 | 0·27 | 7¼ | 0·65 | 1 | 0·09 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 11 | 28 ft. | ... | ... |
| Nov. (15) | ... | ... | 11¼ | 0·75 | 9⅓ | 0·63 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 15 | 28 ft. | 12 | 45 to 56 ft. |
| Dec. (12) | ... | ... | 9 | 0·64 | 9¼ | 0·66 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 14 | 28 to 50 ft. | 76 | 48 to 58 ft. |
| Total for year | 7962⅛ | 8·84 | 1799⅛ | 0·75 | 128⅓ | 0·54 | 9¾ | 0·004 | ... | ... | ... | ... | 7 | 0·008 | ... | ... | ... | ... | 169 | 0·07 | 2379 | | | |

TABLE G.—II. ANSTRUTHER DISTRICT—*continued.* CRAIL.

| Month and Number of Days Fishing. | Quantity of Net and Line Fish caught within the Territorial Waters. | | | | | | | | | | | | | | | | | | | | Number of Trips and Size of Boats Fishing. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Herring. | | Cod. | | Haddock. | | Whiting. | | Lemon Soles. | | Turbot and Brill. | | Plaice and Flounders. | | Dabs. | | Skate. | | Other White Fish. | | Within the Territorial Waters. | | Beyond the Territorial Waters. | |
| 1891. | *Crans.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *No.* | *Size.* | *No.* | *Size.* |
| Jan. (11) | ... | ... | 45 | 1·73 | 39 | 1·5 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 26 | 15 to 27 ft. | ... | ... |
| Feb. (16) | 11½ | 0·24 | 36 | 0·76 | 43 | 0·91 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 47 | 15 to 28 ft. | ... | ... |
| Mar. (20) | 2 | 0·009 | 112 | 0·504 | 42 | 0·18 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 222 | 14 to 28 ft. | ... | ... |
| Apr. (20) | ... | ... | 153 | 0·46 | 41½ | 0·12 | 10½ | 0·32 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 328 | 17 to 28 ft. | ... | ... |
| May (26) | ... | ... | 165 | 0·31 | 157½ | 0·29 | 14 | 0·02 | ... | ... | ... | ... | 5½ | 0·01 | ... | ... | 2½ | 0·004 | ... | ... | 529 | 14 to 20 ft. | 2 | 45 to 47 ft. |
| June (24) | ... | ... | 117 | 0·35 | 74 | 0·22 | 18 | 0·05 | ... | ... | ... | ... | 3 | 0·009 | ... | ... | ... | ... | ... | ... | 332 | 14 to 20 ft. | ... | ... |
| July (27) | ... | ... | 215 | 0·68 | 385 | 1·23 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 313 | 16 to 28 ft. | ... | ... |
| Aug. (20) | 59½ | 0·28 | 62 | 0·29 | 163 | 0·78 | ... | ... | ... | ... | ... | ... | ... | ... | 15½ | 0·07 | ... | ... | ... | ... | 207 | 18 to 30 ft. | ... | ... |
| Sept. (20) | ... | ... | 34¼ | 0·26 | 32¾ | 0·25 | ... | ... | ... | ... | ... | ... | 5½ | 0·04 | 10 | 0·07 | ... | ... | 18¾ | 0·14 | 129 | 18 to 28 ft. | ... | ... |
| Oct. (20) | ... | ... | 166 | 1·24 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 17 | 0·12 | ... | ... | 67 | 0·503 | 133 | 15 to 28 ft. | ... | ... |
| Nov. (20) | ... | ... | 330 | 2·5 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 27 | 0·204 | ... | ... | 28½ | 0·21 | 132 | 16 to 28 ft. | ... | ... |
| Dec. (22) | ... | ... | 393 | 0·27 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 42½ | 0·29 | ... | ... | 42½ | 0·29 | 145 | 15 to 32 ft. | ... | ... |
| Total for year | 73 | 0·02 | 1828¼ | 0·71 | 977¾ | 0·38 | 42½ | 0·01 | ... | ... | ... | ... | 14 | 0·005 | 112 | 0·04 | 2½ | 0·000 | 156¾ | 0·06 | 2543 | | | |

TABLE G.—II. ANSTRUTHER DISTRICT—*continued.* ST. ANDREWS.

| Months and Number of Days Fishing. | Quantity of Net and Line Fish caught within the Territorial Waters. | | | | | | | | | | | | | | | | | | | | Number of Trips and Size of Boats Fishing. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Herring. | | Cod. | | Haddock. | | Whiting. | | Lemon Soles. | | Turbot and Brill. | | Plaice and Flounders. | | Dabs. | | Skate. | | Other White Fish. | | Within the Territorial Waters. | | Beyond the Territorial Waters. | |
| 1891. | *Crans.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *No.* | *Size.* | *No.* | *Size.* |
| Jan. (19) | ... | ... | 115 | 1·25 | 22 | 0·23 | ... | ... | ... | ... | ... | ... | 28 | 0·304 | ... | ... | ... | ... | ... | ... | 92 | 20 to 30 ft. | 221 | 30 to 43 ft. |
| Feb. (24) | ... | ... | 2 | 0·01 | ... | ... | ... | ... | ... | ... | ... | ... | 434 | 2·49 | ... | ... | ... | ... | ... | ... | 174 | 15 to 30 ft. | 170 | 42 to 43 ft. |
| Mar. (18) | ... | ... | 9 | 0·08 | ... | ... | ... | ... | ... | ... | ... | ... | 174 | 1·68 | ... | ... | ... | ... | ... | ... | 103 | 20 to 43 ft. | 72 | 30 to 43 ft. |
| Apr. (17) | ... | ... | 36 | 0·49 | 74 | 1·01 | ... | ... | ... | ... | ... | ... | 14 | 0·19 | 18 | 0·24 | ... | ... | ... | ... | 73 | 20 to 30 ft. | 193 | 88 to 58 ft. |
| May (26) | ... | ... | 10½ | 0·09 | 133 | 1·22 | ... | ... | ... | ... | ... | ... | ... | ... | 58 | 0·53 | ... | ... | ... | ... | 109 | 20 to 30 ft. | 225 | 30 to 58 ft. |
| June (24) | ... | ... | ... | ... | 25 | 1·21 | ... | ... | ... | ... | ... | ... | ... | ... | 167 | 1·45 | ... | ... | ... | ... | 115 | 15 to 30 ft. | 123 | 30 to 58 ft. |
| July (25) | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | .. | ... | 227 | 1·95 | ... | ... | ... | ... | 116 | 18 to 42 ft. | 100 | 30 to 42 ft. |
| Aug. (21) | 35 | 0·29 | ... | ... | 9 | 0·07 | ... | ... | ... | ... | ... | ... | ... | ... | 217 | 1·808 | ... | ... | ... | ... | 120 | 18 to 30 ft. | 21 | 30 to 42 ft. |
| Sept. (21) | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 7 | 0·74 | 189 | 2·01 | ... | ... | ... | ... | 94 | 18 to 30 ft. | 90 | 30 to 58 ft. |
| Oct. (24) | ... | ... | 33 | 0·308 | 67 | 0·62 | ... | ... | ... | ... | ... | ... | 2 | 0·01 | 154 | 1·43 | ... | ... | ... | ... | 107 | 18 to 54 ft. | 157 | 30 to 58 ft. |
| Nov. (19) | ... | ... | 140 | 1·11 | 378 | 3·0 | ... | ... | ... | ... | ... | ... | ... | ... | 38 | 0·301 | ... | ... | ... | ... | 126 | 20 to 43 ft. | 131 | 42 ft. |
| Dec. (25) | ... | ... | 222 | 0·62 | 1490 | 4·18 | ... | ... | ... | ... | ... | ... | ... | ... | 5 | 0·01 | ... | ... | ... | ... | 356 | 20 to 43 ft. | ... | ... |
| Total for year | 35 | 0·022 | 567½ | 0·35 | 2198 | 1·38 | ... | ... | ... | ... | ... | ... | 649 | 0·409 | 1073 | 0·67 | ... | ... | ... | ... | 1585 | | | |

TABLE G.—III. MONTROSE DISTRICT. BROUGHTY FERRY.

| Months and Number of Days Fishing. | Quantity of Net and Line Fish caught within the Territorial Waters. | | | | | | | | | | | | | | | | | | | | Number of Trips and Size of Boats Fishing. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Herring. | | Cod. | | Haddock. | | Whiting. | | Lemon Soles. | | Turbot. and Brill. | | Plaice and Flounders. | | Dabs. | | Skate. | | Other White Fish. | | Within the Territorial Waters. | | Beyond the Territorial Waters. | |
| | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *No.* | *Size.* | *No.* | *Size.* |
| 1891. Jan. (21) | 147 | 1·27 | 7¾ | 0·06 | 77 | 0·66 | 7 | 0·06 | ... | ... | ... | ... | 59 | 0·51 | 1 | 0·008 | ... | ... | 20 | 0·17 | 115 | 18 to 30 ft. | 170 | 30 to 55 ft. |
| Feb. (21) | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 722 | 2·54 | ... | ... | ... | ... | ... | ... | 284 | 18 to 34 ft. | 221 | 40 to 55 ft. |
| Mar. (15) | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 379 | 2·05 | ... | ... | ... | ... | ... | ... | 184 | 18 to 45 ft. | 14 | 35 to 55 ft. |
| Apr. (16) | ... | ... | 37 | 0·27 | 70½ | 0·51 | ... | ... | ... | ... | ... | ... | 123½ | 0·908 | 31 | 0·22 | ... | ... | 28 | 0·205 | 136 | 15 to 30 ft. | 124 | 30 to 50 ft. |
| May (18) | ... | ... | 8½ | 0·06 | 93 | 0·73 | 7½ | 0·05 | ... | ... | ... | ... | 84½ | 0·66 | 33 | 0·25 | ... | ... | 18 | 0·14 | 127 | 18 to 30 ft. | 177 | 30 to 50 ft. |
| June (15) | ... | ... | ... | ... | 10½ | 0·205 | 1¾ | 0·03 | ... | ... | ... | ... | 20 | 0·39 | 69 | 1·35 | ... | ... | 8 | 0·15 | 51 | 18 to 2[illegible] ft. | 133 | 30 to 50 ft. |
| July (13) | ... | ... | 4 | 0·23 | ... | ... | 1 | 0·05 | ... | ... | ... | ... | 7 | 0·41 | 26½ | 1·55 | ... | ... | 9½ | 0·55 | 17 | 18 to 20 ft. | 9 | 36 ft. |
| Aug. | | No | fishing. | | | | | | | | | | | | | | | | | | | | | |
| Sept. (14) | ... | ... | ¼ | 0·005 | 7 | 0·14 | 1½ | 0·02 | ... | ... | ... | ... | 20½ | 0·41 | 58½ | 1·19 | ... | ... | 17 | 0·34 | 49 | 18 to 30 ft. | 121 | 30 to 50 ft. |
| Oct. (14) | ... | ... | 5 | 0·76 | 48½ | 0·74 | 2¾ | 0·42 | ¼ | 0·003 | ... | ... | 15½ | 0·23 | 48 | 0·73 | ... | ... | 13 | 0·2 | 65 | 18 to 30 ft. | 122 | 30 to 50 ft. |
| Nov. (6) | ... | ... | 1 | 0·06 | 11 | 0·73 | ... | ... | ... | ... | ... | ... | 2¼ | 0·15 | 9 | 0·6 | ... | ... | 1½ | 0·1 | 15 | 18 to 30 ft. | 90 | 30 to 50 ft. |
| Dec. (5) | ... | ... | 3 | 0·18 | 11 | 0·68 | ... | ... | ... | ... | ... | ... | 3¼ | 0·203 | 8 | 0·5 | ... | ... | 2¾ | 0·17 | 16 | 20 to 30 ft. | 72 | 30 to 35 ft. |
| Total for year | 147 | 0·13 | 66½ | 0·06 | 328½ | 0·31 | 21¼ | 0·02 | ¼ | 0·000 | ... | ... | 1436½ | 1·35 | 284 | 0·26 | ... | ... | 117¾ | 0·11 | 1059 | | | |

TABLE G.—III. MONTROSE DISTRICT—*continued*. ARBROATH.

| Month and Number of Days Fishing. | Quantity of Net and Line Fish caught within the Territorial Waters. | | | | | | | | | | | | | | | | | | | | Number of Trips and Size of Boats Fishing. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Herring. | | Cod. | | Haddock. | | Whiting. | | Lemon Soles. | | Turbot and Bril. | | Plaice and Flounders. | | Dabs. | | Skate. | | Other White Fish. | | Within the Territorial Waters. | | Beyond the Territorial Waters. | |
| 1891. | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *No.* | *Size.* | *No.* | *Size.* |
| Jan (21) | 5 | 0·06 | 18 | 0·24 | 59½ | 0·804 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 57 | 0·77 | 74 | 18 to 30 ft. | 539 | 30 to 45 ft. |
| Feb. (19) | 45 | 0·803 | 8 | 0·14 | 36½ | 0·65 | ... | ... | ... | ... | ... | ... | ... | .. | 2½ | 0·04 | ... | ... | 44 | 0·78 | 56 | 18 to 30 ft. | 498 | 30 to 45 ft. |
| Mar. (15) | ... | ... | ½ | 0·005 | ½ | 0·005 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 80 | 0·84 | 95 | 18 to 30 ft. | 267 | 30 to 45 ft. |
| Apr. (18) | ... | ... | ... | ... | 45 | 0·47 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 29 | 0·305 | 95 | 18 to 30 ft. | 261 | 30 to 50 ft. |
| May (19) | ... | ... | 4 | 0·05 | 49 | 0·65 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 22 | 0·29 | 75 | 18 to 30 ft. | 251 | 30 to 50 ft. |
| June (22) | ... | ... | 3 | 0·03 | 52 | 0·56 | 6½ | 0·07 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 41 | 0·44 | 92 | 18 to 30 ft. | 287 | 30 to 50 ft. |
| July (24) | ... | ... | 4 | 0·05 | 58 | 0·77 | 3 | 0·04 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 22 | 0·29 | 75 | 18 to 30 ft. | 87 | 30 to 50 ft. |
| Aug. (20) | ... | ... | ... | ... | 33 | 0·61 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 20 | 0·37 | 54 | 18 to 30 ft. | 62 | 30 to 45 ft. |
| Sept. (15) | ... | ... | ... | ... | 25½ | 0·607 | ... | ... | ... | ... | ... | ... | ... | ... | 3½ | 0·08 | ... | ... | 13½ | 0·32 | 42 | 18 to 30 ft. | 141 | 30 to 50 ft. |
| Oct. (19) | ... | ... | ... | ... | 18½ | 0·34 | 6½ | 0·012 | ... | ... | ... | ... | ... | ... | 8 | 0·15 | ... | ... | 41½ | 0·78 | 53 | 18 to 30 ft. | 381 | 30 to 50 ft. |
| Nov. (21) | ... | ... | 5 | 0·04 | 16½ | 0·15 | ... | ... | ... | ... | ... | ... | ... | ... | 6¾ | 0·06 | ... | ... | 131 | 1·25 | 104 | 18 to 45 ft. | 465 | 30 to 45 ft. |
| Dec. (22) | ... | ... | 112½ | 0·62 | 1 | 0·005 | ... | ... | ... | ... | ... | ... | ... | ... | 2 | 0·01 | ... | ... | 280 | 1·56 | 179 | 18 to 30 ft. | 452 | 30 to 45 ft. |
| Total for year. | 50 | 0·05 | 155 | 0·15 | 395 | 0·39 | 16 | 0·01 | ... | ... | ... | ... | ... | ... | 22¾ | 0·02 | ... | ... | 781 | 0·78 | 994 | | | |

TABLE G.—III. MONTROSE DISTRICT—*continued*. AUCHMITHIE.

| Month and Number of Days Fishing. | Quantity of Net and Line Fish caught within the Territorial Waters. | | | | | | | | | | | | | | | | | | | | Number of Trips and Size of Boats Fishing. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Herring. | | Cod. | | Haddock. | | Whiting. | | Lemon Soles. | | Turbot. and Brill. | | Plaice and Flounders. | | Dabs. | | Skate. | | Other White Fish. | | Within the Territorial Waters. | | Beyond the Territorial Waters. | |
| 1891. | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *No.* | *Size.* | *No.* | *Size.* |
| Jan. (6) | ... | | 11 | 0·39 | 58 | 2·07 | 13 | 0·46 | ... | ... | ... | ... | 1½ | 0·053 | ... | ... | ... | ... | 18 | 0·64 | 28 | 18 ft. | 150 | 18 to 28 ft. |
| Feb. (16) | ... | | 13 | 0·36 | 64 | 1·77 | 13 | 0·36 | ... | ... | ... | ... | 2½ | 0·069 | ... | ... | 1½ | 0·041 | 19 | 0·52 | 36 | 18 ft. | 142 | 18 to 28 ft. |
| Mar. (16) | ... | | 169 | 1·29 | 53 | 0·404 | 24 | 0·18 | ... | ... | ... | ... | 12 | 0·091 | ... | ... | 5½ | 0·041 | 52 | 0·39 | 131 | 18 to 20 ft. | 14 | 28 ft. |
| Apr. (5) | ... | | 18½ | 0·43 | 71 | 1·65 | 11½ | 0·26 | ... | ... | ... | ... | ... | | ... | ... | 2 | 0·046 | 19½ | 0·45 | 43 | 18 to 20 ft. | 156 | 18 to 20 ft. |
| May (4) | ... | | 10½ | 0·29 | 65 | 1·805 | 10½ | 0·29 | ... | ... | ... | ... | 2½ | 0·069 | ... | ... | 2½ | 0·069 | 10 | 0·27 | 36 | 18 to 20 ft. | 145 | 18 to 20 ft. |
| June (5) | ... | | 10 | 0·27 | 68 | 1·88 | 11 | 0·305 | ... | ... | ... | ... | 2½ | 0·069 | ... | ... | 3½ | 0·097 | 15½ | 0·43 | 36 | 18 to 20 ft. | 150 | 18 to 20 ft. |
| July (5) | ... | | ... | ... | 26 | 2·16 | 3½ | 0·29 | ... | ... | ... | ... | 1 | 0·083 | ... | ... | 1 | 0·083 | 3½ | 0·29 | 12 | 16 to 18 ft. | 64 | 18 to 20 ft. |
| Aug. (5) | ... | | 2¼ | 0·22 | 20 | 2·00 | 3 | 0·30 | ... | ... | ... | ... | ¾ | 0·075 | ... | ... | ¼ | 0·025 | 3 | 0·30 | 10 | 16 to 18 ft. | 33 | 18 to 20 ft. |
| Sept. (4) | ... | | 2 | 0·07 | 17 | 0·607 | 6 | 0·21 | ... | ... | ... | ... | ½ | 0·17 | ... | ... | ½ | 0·017 | 11 | 0·39 | 28 | 18 to 20 ft. | 93 | 18 to 20 ft. |
| Oct. (6) | ... | | 5½ | 0·11 | 103 | 2·23 | 16 | 0·34 | ... | ... | ... | ... | 2½ | 0·054 | ... | ... | 1½ | 0·032 | 18 | 0·39 | 46 | 18 to 20 ft. | 97 | 18 to 20 ft. |
| Nov. (6) | ... | | 5½ | 0·11 | 84 | 1·82 | 9 | 0·19 | ... | ... | ... | ... | 2½ | 0·054 | ... | ... | 2 | 0·043 | 11 | 0·23 | 46 | 18 to 20 ft. | 179 | 18 to 20 ft. |
| Dec. (16) | ... | | 9 | 0·04 | 29½ | 0·15 | 7½ | 0·03 | ... | ... | ... | ... | 3½ | 0·018 | ... | ... | 2½ | 0·011 | 178 | 0·94 | 189 | 18 to 20 ft. | 62 | 18 to 20 ft. |
| Total for year. | ... | | 256¼ | 0·402 | 658½ | 1·027 | 128 | 0·19 | ... | ... | ... | ... | 31¾ | 0·049 | ... | ... | 22¾ | 0·035 | 358½ | 0·55 | 641 | | | |

TABLE G.—III. MONTROSE DISTRICT—*continued*. MONTROSE.

| Month and Number of Days Fishing. | Quantity of Net and Line Fish caught within the Territorial Waters. | | | | | | | | | | | | | | | | | | | | Number of Trips and Size of Boats Fishing. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Herring. | | Cod. | | Haddock. | | Whiting. | | Lemon Soles. | | Turbot and Brill. | | Plaice and Flounders. | | Dabs. | | Skate. | | Other White Fish. | | Within the Territorial Waters. | | Beyond the Territorial Waters. | |
| 1891. | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *No.* | *Size.* | *No.* | *Size.* |
| Jan. (20) | ... | | 39 | 0·307 | 448 | 3·52 | 44 | 0·34 | ... | ... | ... | ... | 2 | 0·01 | 8¾ | 0·06 | ... | ... | 36 | 0·28 | 127 | 18 to 40 ft. | 747 | 30 to 54 ft. |
| Feb. (24) | ... | | 29½ | 0·09 | 371 | 1·204 | 26 | 0·08 | ... | ... | ... | ... | 141 | 0·45 | 11¼ | 0·03 | ... | ... | 26 | 0·08 | 308 | 12 to 35 ft. | 574 | 18 to 54 ft. |
| Mar. (8) | ... | | 23 | 0·67 | 14½ | 0·42 | 5¼ | 0·16 | ... | ... | ... | ... | 15½ | 0·45 | 3 | 0·08 | ... | .. | 31 | 0·91 | 34 | 12 to 20 ft. | 250 | 25 to 54 ft. |
| Apr. (9) | ... | | 11 | 0·24 | 15 | 0·33 | 6¼ | 0·14 | ... | ... | ... | ... | 5 | 0·11 | 2½ | 0·05 | ... | ... | 23¼ | 0·52 | 45 | 18 ft. | 339 | 18 to 54 ft. |
| May (14) | ... | | 9¾ | 0·21 | 22 | 0·47 | 16 | 0·34 | ... | ... | ... | ... | 5½ | 0·11 | 9 | 0·19 | ... | ... | 14 | 0·304 | 46 | 18 ft. | 500 | 18 to 54 ft. |
| June | ... | | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 254 | 18 to 40 ft. |
| July (14) | ... | | 7½ | 0·25 | 5½ | 0·18 | 3 | 0·10 | ... | ... | ... | ... | 1¼ | 0·04 | 3½ | 0·11 | ... | ... | 23 | 0·76 | 30 | 18 ft. | 218 | 18 to 35 ft. |
| Aug. (6) | ... | | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 9 | 0·52 | 17 | 16 to 18 ft. | 156 | 18 to 35 ft. |
| Sept. (1) | ... | | 1 | 0·20 | 3 | 0·60 | 3 | 0·60 | ... | ... | ... | ... | 1 | 0·20 | 2 | 0·40 | ... | ... | 2 | 0·40 | 5 | 18 to 30 ft. | 407 | 18 to 54 ft. |
| Oct. (25) | ... | | 19¾ | 0·02 | 77½ | 0·08 | 115 | 0·12 | ... | ... | ... | ... | 240 | 0·27 | 34¾ | 0·03 | ... | ... | 27 | 0·03 | 886 | 12 to 30 ft. | 602 | 30 to 54 ft. |
| Nov. (20) | ... | | 24½ | 0·06 | 71 | 0·18 | 36½ | 0·09 | ... | ... | 1½ | 0·004 | 45 | 0·12 | 14¼ | 0·03 | ... | ... | 47 | 0·12 | 375 | 12 to 30 ft. | 371 | 30 to 54 ft. |
| Dec. (26) | ... | | 60 | 0·102 | 118 | 0·20[illegible] | 11 | 0·01 | ... | ... | ... | ... | 76 | 0·13 | 29 | 0·04 | ... | ... | 33 | 0·05 | 583 | 12 to 30 ft. | 478 | 18 to 54 ft. |
| Total for year | ... | ... | 225 | 0·09 | 1245½ | 0·507 | 266½ | 0·108 | ... | ... | 1½ | 0·000 | 532¼ | 0·21 | 118¼ | 0·04 | ... | ... | 271½ | 0·106 | 2456 | | | |

TABLE G.—III. MONTROSE DISTRICT—*continued.* JOHNSHAVEN.

| Month and Number of Days Fishing. | Quantity of Net and Line Fish caught within the Territorial Waters. | | | | | | | | | | | | | | | | | | | | Number of Trips and Size of Boats Fishing. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Herring. | | Cod. | | Haddock. | | Whiting. | | Lemon Soles. | | Turbot and Brill. | | Plaice and Flounders. | | Dabs. | | Skate. | | Other White Fish. | | Within the Territorial Waters. | | Beyond the Territorial Waters. | |
| 1891. | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *No.* | *Size.* | *No.* | *Size.* |
| Jan. (22) | ... | | 53 | 0·23 | 1229 | 5·51 | 3¼ | 0·15 | ... | | ⅛ | 0·000 | 1 | 0·004 | ... | | ... | | 90 | 0·403 | 223 | 18 to 35 ft. | 158 | 22 to 35 ft. |
| Feb. (22) | 4 | 0·03 | 36½ | 0·33 | 298 | 2·75 | 18¼ | 0·17 | ... | | ... | | 4½ | 0·04 | ... | | ... | | 158 | 1·46 | 108 | 18 to 25 ft. | 247 | 25 to 35 ft. |
| Mar. (23) | ... | | 47 | 0·37 | 33½ | 0·27 | 11½ | 0·09 | ... | | ... | | 12 | 0·09 | ... | | ... | | 218 | 1·75 | 124 | 18 to 22 ft. | 88 | 22 to 35 ft. |
| Apr. (19) | ... | | 18 | 0·14 | 85 | 0·67 | 30 | 0·23 | ... | | ... | | 10 | 0·07 | ... | | ... | | 63½ | 0·503 | 126 | 18 to 22 ft. | 103 | 22 to 45 ft. |
| May (20) | ... | | 4½ | 0·04 | 101 | 0·95 | 16½ | 0·15 | ... | | ... | | 2 | 0·01 | ... | | ... | | 16 | 0·15 | 106 | 18 to 22 ft. | 44 | 35 to 50 ft. |
| June (24) | ... | | 6 | 0·05 | 104½ | 0·90 | 25½ | 0·21 | ... | | ... | | 1 | 0·008 | ... | | ... | | 22 | 0·18 | 116 | 14 to 18 ft. | 67 | 35 to 50 ft. |
| July (17) | ... | | ... | | 34 | 0·79 | 21¼ | 0·50 | ... | | ... | | ... | | ... | | ... | | 12 | 0·27 | 43 | 16 to 24 ft. | 36 | 22 to 40 ft. |
| Aug. (8) | ... | | ... | | 9 | 0·90 | 6 | 0·60 | ... | | ... | | ... | | ... | | ... | | ... | | 10 | 18 ft. | 24 | 18 to 22 ft. |
| Sept. (4) | ... | | ... | | 10½ | 0·87 | 10¼ | 0·87 | ... | | ... | | ... | | ... | | ... | | 2½ | 0·208 | 12 | 18 to 22 ft. | 1 | 36 ft. |
| Oct. (11) | ... | | 2 | 0·03 | 47 | 0·83 | 16 | 0·28 | ... | | ¼ | 0·004 | 4 | 0·071 | ... | | ... | | 27½ | 0·49 | 56 | 18 to 25 ft. | 88 | 22 to 35 ft. |
| Nov. (13) | ... | | 15½ | 0·23 | 24 | 0·36 | ... | | ... | | ... | | ... | | ... | | | | 81 | 1·22 | 66 | 18 to 22 ft. | 177 | 25 to 35 ft. |
| Dec. (17) | ... | | 55 | 0·71 | 36 | 0·46 | ... | | ... | | ... | | ... | | ... | | ... | | 83 | 1·07 | 77 | 22 to 24 ft. | 137 | 24 to 35 ft. |
| Total for year | 4 | 0·03 | 237½ | 0·02 | 2011½ | 1·88 | 190 | 0·17 | ... | | ⅜ | 0·000 | 34½ | 0·032 | ... | | ... | | 683½ | 0·64 | 1067 | | | |

TABLE G.—III. MONTROSE DISTRICT—*continued.* GOURDON.

| Month and Number of Days Fishing. | Quantity of Net and Line Fish caught within the Territorial Waters. | | | | | | | | | | | | | | | | | | | | | Number of Trips and Size of Boats Fishing. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Herring. | | Cod. | | Haddock. | | Whiting. | | Lemon Soles. | | Turbot and Brill. | | Plaice and Flounders. | | Dabs. | | Skate. | | Other White Fish. | | Within the Territorial Waters. | | Beyond the Territorial Waters. | |
| | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *No.* | *Size.* | *No.* | *Size.* |
| 1891. Jan. (21) | ... | ... | 119 | 0·36 | 2138 | 6·47 | 18 | 0·054 | ... | ... | ... | ... | 13½ | 0·04 | ... | ... | ... | ... | 237 | 0·71 | 330 | 18 to 24 ft. | 384 | 24 to 36 ft. |
| Feb. (22) | ... | ... | 144 | 0·34 | 2598 | 6·17 | 82 | 0·19 | 3 | 0·007 | ... | ... | 20 | 0·04 | ... | ... | ... | ... | 314 | 0·74 | 421 | 18 to 26 ft. | 524 | 26 to 36 ft. |
| Mar. (18) | ... | ... | 162 | 0·507 | 559 | 1·75 | 49 | 0·15 | 3 | 0·009 | ¼ | 0·000 | 5¼ | 0·01 | ... | ... | ... | ... | 365 | 1·14 | 319 | 18 to 26 ft. | 388 | 26 to 36 ft. |
| Apr. (18) | ... | ... | 362 | 1·01 | 686 | 1·92 | 140 | 0·39 | 4 | 0·011 | ... | ... | 8¼ | 0·02 | ... | ... | ... | ... | 322 | 0·901 | 357 | 17 to 26 ft. | 464 | 28 to 38 ft. |
| May (19) | ... | ... | 152 | 0·47 | 425 | 1·31 | 111 | 0·34 | 2¼ | 0·006 | ... | ... | ... | ... | ... | ... | ... | ... | 139 | 0·43 | 322 | 17 to 26 ft. | 395 | 26 to 38 ft. |
| June (21) | ... | ... | 159 | 0·45 | 433 | 1·23 | 138 | 0·39 | 1¼ | 0·003 | ... | ... | ¾ | 0·001 | 1½ | 0·004 | ... | ... | 144 | 0·41 | 350 | 17 to 26 ft. | 302 | 26 to 51 ft. |
| July (19) | ... | ... | 58 | 0·24 | 335 | 1·40 | 98 | 0·41 | ¼ | 0·001 | ½ | 0·002 | 4 | 0·01 | ¾ | 0·003 | 2 | 0·008 | 85 | 0·35 | 239 | 17 to 26 ft. | 51 | 26 to 36 ft. |
| Aug. (17) | ... | ... | 22 | 0·09 | 373 | 1·68 | 98 | 0·44 | ¼ | 0·001 | ... | ... | ¼ | 0·001 | 6½ | 0·029 | ... | ... | 106 | 0·47 | 221 | 17 to 26 ft. | 48 | 26 to 36 ft. |
| Sept. (13) | ... | ... | ... | ... | 60 | 1·00 | 11 | 0·18 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 47 | 0·78 | 60 | 20 to 32 ft. | 419 | 24 to 39 ft. |
| Oct. (11) | ... | ... | 18 | 0·46 | 30½ | 0·78 | 3½ | 0·08 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 78¼ | 2·01 | 39 | 18 to 34 ft. | 509 | 20 to 39 ft. |
| Nov. (8) | ... | ... | ... | ... | 17 | 0·58 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 27 | 0·93 | 29 | 20 to 25 ft. | 604 | 20 to 39 ft. |
| Dec. (13) | ... | ... | 70 | 1·40 | 28 | 0·56 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 43 | 0·86 | 50 | 27 to 32 ft. | 541 | 28 to 39 ft. |
| Total for year | ... | ... | 1266 | 0·46 | 7682½ | 2·806 | 748½ | 0·27 | 14 | 0·005 | ¾ | 0·000 | 52 | 0·018 | 8¾ | 0·003 | 2 | 0·000 | 1907¼ | 0·69 | 2737 | | | |

TABLE G.—IV. STONEHAVEN DISTRICT. SHIELDHILL TO SKATERAW.

| Month and Number of Days Fishing. | Quantity of Net and Line Fish caught within the Territorial Waters. | | | | | | | | | | | | | | | | | | | | Number of Trips and Size of Boats Fishing. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Herring. | | Cod. | | Haddock. | | Whiting. | | Lemon Soles. | | Turbot and Brill. | | Plaice and Flounders. | | Dabs. | | Skate. | | Other White Fish. | | Within the Territorial Waters. | | Beyond the Territorial Waters. | |
| | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *Cwts.* | *Aver.* | *No.* | *Size.* | *No.* | *Size.* |
| 1891. Jan. (24) | 16 | 0·01 | 769 | 0·65 | 5209 | 4·43 | 289 | 0·24 | ... | ... | 1 | 0·000 | 13 | 0·011 | ... | ... | 2 | 0·001 | 18 | 0·01 | 1174 | 16 to 40 ft. | 405 | 20 to 40 ft. |
| Feb. (24) | 28 | 0·02 | 579 | 0·53 | 4142 | 3·81 | 162 | 0·14 | ... | ... | 1 | 0·000 | 26 | 0·02 | ... | ... | ... | ... | 24 | 0·02 | 1087 | 16 to 40 ft. | 500 | 24 to 40 ft. |
| Mar. (16) | ... | ... | 328 | 1·17 | 169 | 0·605 | 44 | 0·15 | ... | ... | ... | ... | 6 | 0·02 | ... | ... | ... | ... | 4 | 0·01 | 279 | 16 to 40 ft. | 355 | 22 to 40 ft. |
| Apr. (20) | ... | ... | 523 | 0·91 | 620 | 1·08 | 209 | 0·36 | ... | ... | ... | ... | 7½ | 0·01 | ... | ... | ... | ... | 8 | 0·01 | 574 | 16 to 30 ft. | 346 | 22 to 60 ft. |
| May (24) | ... | ... | 488 | 0·65 | 501 | 0·75 | 243 | 0·36 | ... | ... | ... | ... | 8 | 0·01 | ... | ... | ... | ... | 9 | 0·01 | 664 | 16 to 24 ft. | 208 | 16 to 55 ft. |
| June (26) | ... | ... | 285 | 0·36 | 1116 | 1·44 | 437 | 0·55 | ... | ... | ... | ... | 9 | 0·01 | ... | ... | ... | ... | 87 | 0·04 | 771 | 16 to 24 ft. | 225 | 18 to 58 ft. |
| July (25) | ... | ... | 71 | 0·15 | 543 | 1·17 | 410 | 0·88 | ... | ... | ... | ... | 8 | 0·01 | ... | ... | ... | ... | 23 | 0·04 | 462 | 16 to 24 ft. | 510 | 22 to 60 ft. |
| Aug. (24) | ... | ... | 59 | 0·102 | 561 | 0·97 | 591 | 1·02 | ... | ... | ... | ... | 14 | 0·02 | ... | ... | ... | ... | 44 | 0·07 | 576 | 16 to 24 ft. | 766 | 18 to 60 ft. |
| Sept. (24) | ... | ... | 62 | 0·15 | 451 | 1·09 | 321 | 0·77 | ... | ... | ... | ... | 25 | 0·06 | ... | ... | ... | ... | 22 | 0·05 | 413 | 16 to 24 ft. | 520 | 16 to 60 ft. |
| Oct. (23) | ... | ... | 301 | 0·45 | 628 | 0·94 | 457 | 0·68 | ... | ... | ... | ... | 20 | 0·02 | ... | ... | ... | ... | 13 | 0·01 | 667 | 16 to 40 ft. | 821 | 26 to 40 ft. |
| Nov. (19) | ... | ... | 172 | 0·52 | 271 | 0·82 | 258 | 0·78 | ... | ... | ... | ... | 9 | 0·02 | ... | ... | ... | ... | 15 | 0·04 | 329 | 16 to 40 ft. | 855 | 18 to 40 ft. |
| Dec. (25) | ... | ... | 403 | 0·56 | 596 | 0·85 | 116 | 0·15 | ... | ... | ... | ... | 11 | 0·01 | ... | ... | 3 | 0·004 | 22 | 0·03 | 695 | 16 to 40 ft. | 617 | 16 to 40 ft. |
| Total for year | 44 | 0·005 | 3990 | 0·51 | 14807 | 1·92 | 3537 | 0·45 | ... | ... | 2 | 0·000 | 156½ | 0·02 | ... | ... | 5 | 0·000 | 239 | 0·03 | 7691 | | | |

TABLE H.—Showing the Quantities of Fish (in Cwts.) captured by Line Fishermen in the Territorial Waters of certain districts, with the Average per 'shot' in 1889, 1890 and 1891.

*Note.*—The Decimal figures in the second columns give the average cwts. per 'shot.'

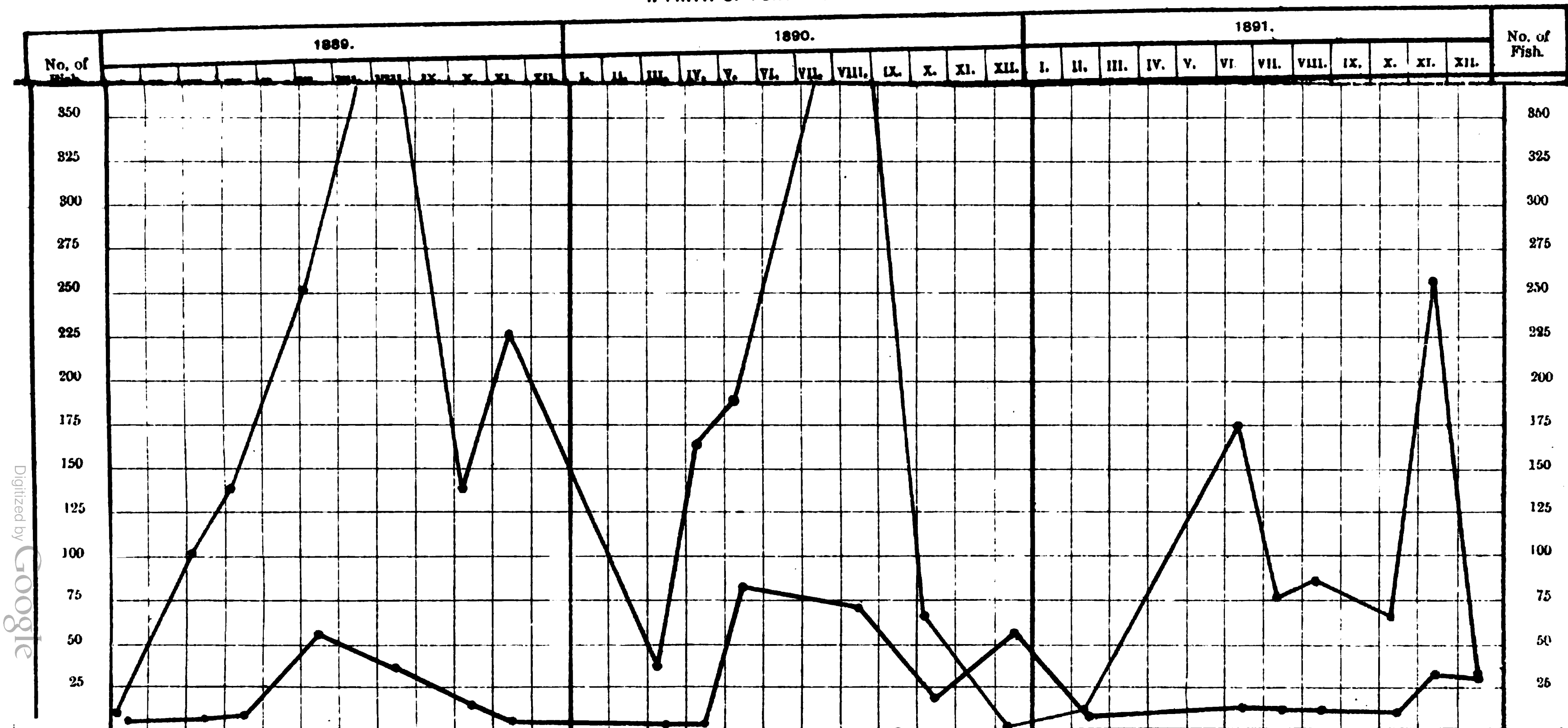
| DISTRICT. | Cod. | | Haddock. | | Whiting. | | Lemon Soles, Flounders and Dabs. | | Skate and Turbot. | | Other White Fish. | | Total Fish. | | Total Trips. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1889.** | | | | | | | | | | | | | | | |
| Leith, | 9,858½ | 0·96 | 6,576½ | 0·64 | 649 | 0·06 | 1,885½ | 0·18 | 614 | 0·06 | 1,510¼ | 0·14 | 21,093¾ | 2·062 | 10,227 |
| Anstruther, | 14,730½ | 0·95 | 12,170¾ | 0·81 | 1,861¼ | 0·12 | 2,979½ | 0·19 | 198 | 0·01 | 457¾ | 0·02 | 32,397¼ | 2·094 | 15,468 |
| Montrose, | 12,777½ | 1·27 | 15,779½ | 1·57 | 3,532 | 0·15 | 1,711¼ | 0·17 | 55¼ | 0·005 | 3,838¾ | 0·38 | 37,694¼ | 3·764 | 10,014 |
| Stonehaven, | 3,049½ | 0·42 | 9,281 | 1·29 | 2,807 | 0·39 | 195½ | 0·02 | 50 | 0·00 | 461 | 0·06 | 15,844 | 2·204 | 7,189 |
| Total, | 40,416 | 0·941 | 43,807¼ | 1·021 | 8,849¼ | 0·206 | 6,771¾ | 0·157 | 917¼ | 0·021 | 6,267¾ | 0·146 | 107,029¼ | 2·494 | 42,898 |
| **1890.** | | | | | | | | | | | | | | | |
| Leith, | 8,534 | 1·08 | 4,933⅓ | 0·62 | 983 | 0·12 | 2,593¾ | 0·32 | 623¼ | 0·07 | 666 | 0·08 | 18,333¼ | 2·325 | 7,885 |
| Anstruther, | 9,572⅜ | 0·80 | 9,427 7/12 | 0·79 | 1,801 | 0·15 | 3,571⅝ | 0·30 | 10½ | 0·000 | 447¾ | 0·03 | 24,831⅓ | 2·097 | 11,841 |
| Montrose, | 1,267⅞ | 0·16 | 11,659¼ | 1·54 | 2,122 | 0·28 | 994¼ | 0·13 | 27 | 0·003 | 3,519½ | 0·46 | 19,589⅓ | 2·595 | 7,547 |
| Stonehaven, | 2,949 | 0·40 | 13,552 | 1·87 | 4,001 | 0·55 | 211 | 0·02 | 15½ | 0·002 | 209½ | 0·02 | 20,938 | 2·896 | 7,228 |
| Total, | 22,323⅝ | 0·64 | 39,572 1/12 | 1·14 | 8,907 | 0·25 | 7,370⅝ | 0·21 | 676¼ | 0·01 | 4,842¾ | 0·11 | 83,692¼ | 2·425 | 34,501 |
| **1891.** | | | | | | | | | | | | | | | |
| Leith, | 12,474½ | 1·63 | 5,017½ | 0·65 | 1,564¼ | 0·20 | 1,805 | 0·23 | 602 | 0·07 | 944 | 0·12 | 22,407 | 2·943 | 7,613 |
| Anstruther, | 10,129½ | 0·74 | 9,845 | 0·72 | 1,620¾ | 0·11 | 2,722 | 0·19 | 2½ | 0·00 | 430 | 0·03 | 24,749¾ | 1·810 | 13,670 |
| Montrose, | 2,206¼ | 0·24 | 12,321½ | 1·86 | 1,370½ | 0·15 | 2,535 | 0·28 | 24¾ | 0·00 | 4,119¾ | 0·46 | 22,577¾ | 2·521 | 8,954 |
| Stonehaven, | 3,990 | 0·51 | 14,807 | 1·92 | 3,537 | 0·54 | 156½ | 0·02 | 5 | 0·00 | 239 | 0·03 | 22,784½ | 2·956 | 7,691 |
| Total, | 28,800¼ | 0·75 | 41,991 | 1·13 | 8,092½ | 0·21 | 7,218½ | 0·19 | 634¼ | 0·01 | 5,732¾ | 0·15 | 92,469 | 2·438 | 37,928 |

PLATE I.

## CHART showing the Results of the "Garland's" Trawlings.

*The red line gives the average per "Shot" of flat fish; the black line gives the average per "shot" of round fish.*

### I. FIRTH OF FORTH—CLOSED AREA.




104,000
104,000
52,000

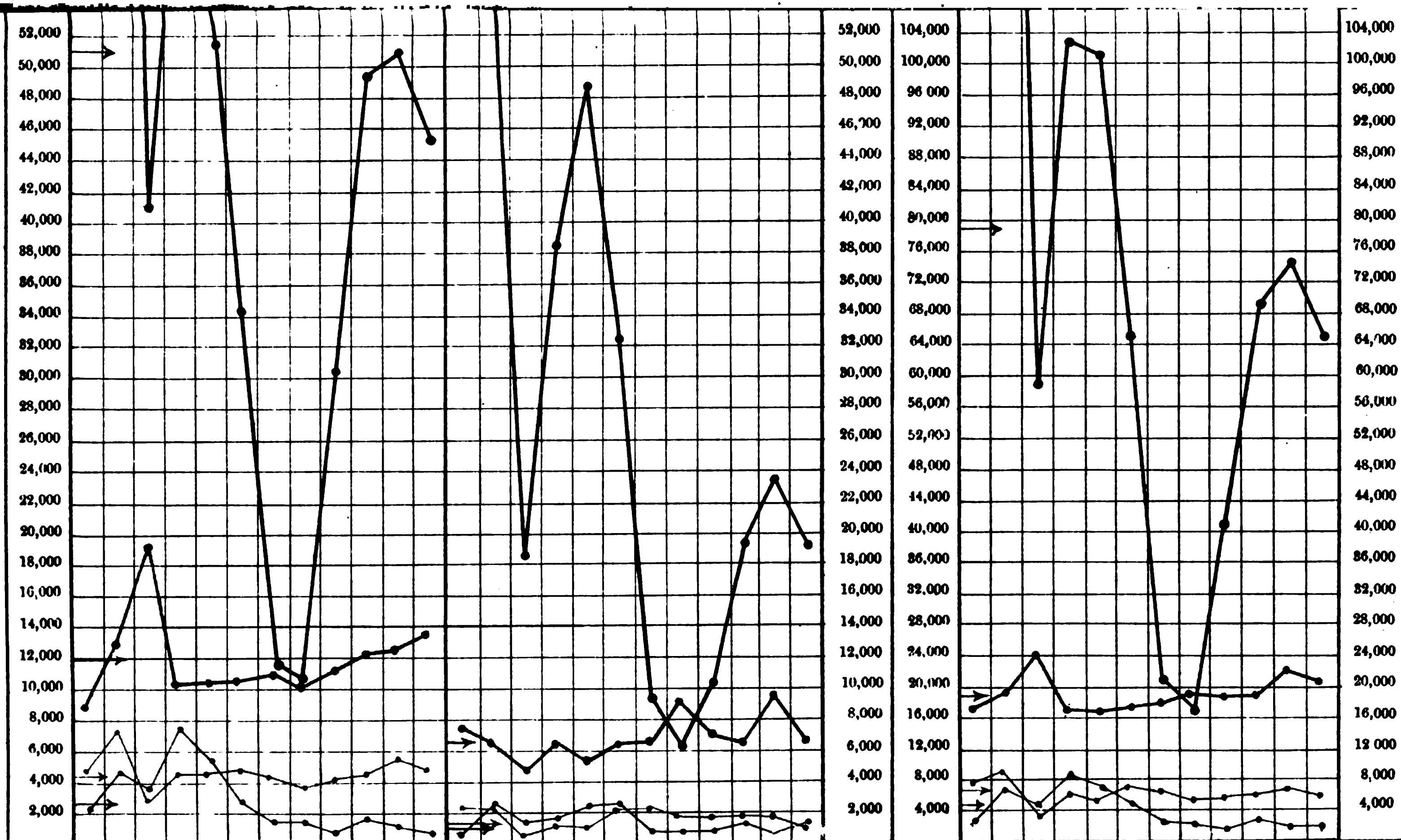

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**TABLE I.—Showing the Monthly Amounts in cwts. o Round and Flat Fish landed by Line Fishermen and Beam Trawlers on the East Coast of Scotland during 1891.**

| MONTH. | Northern Section (from Aberdeen northwards). | | | | Southern Section (south of Aberdeen). | | | | Whole East Coast. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Round Fish. | | Flat Fish. | | Round Fish. | | Flat Fish. | | Round Fish. | | Flat Fish. | |
| | Line. | Beam Trawl. | Line. | Beam Trawl. | Line. | Beam Trawl. | Line. | Beam Trawl. | Line. | Beam Trawl. | Line. | Beam Trawl. |
| January, . . . . . . | 81,462 | 8,899 | 2,377 | 4,935 | 58,747 | 7,766 | 704 | 2,275 | 140,209 | 16,665 | 3,081 | 7,210 |
| February, . . . . . | 144,605 | 13,042 | 4,708 | 7,246 | 54,235 | 6,484 | 2,875¼ | 2,054 | 198,840 | 19,526 | 7,583½ | 9,300 |
| March, . . . . . . | 41,442 | 19,427 | 3,955½ | 2,864 | 18,524 | 4,623 | 1,501 | 555¾ | 59,966 | 24,050 | 5,456½ | 3,419¾ |
| April, . . . . . . | 65,144 | 10,496 | 7,588 | 4,761 | 38,520½ | 6,516 | 1,714¼ | 1,253¾ | 103,664½ | 17,012 | 9,302¼ | 6,014¾ |
| May, . . . . . . | 51,996½ | 10,551 | 5,477½ | 4,806 | 48,810 | 5,573 | 2,091¾ | 1,110 | 100,806½ | 16,124 | 7,569¼ | 5,416 |
| June, . . . . . . | 34,033 | 10,857 | 2,810 | 5,040 | 32,094 | 6,607 | 2,170 | 2,067 | 66,127 | 17,464 | 4,980 | 7,107 |
| July, . . . . . . | 11,991 | 11,263 | 1,664¾ | 4,275 | 9,480 | 6,678 | 756½ | 2,172 | 21,471 | 17,941 | 2,421¼ | 6,447 |
| August, . . . . . . | 10,704 | 10,317 | 1,761 | 3,804 | 6,114 | 9,207 | 629 | 1,848¾ | 16,818 | 19,524 | 2,390 | 5,652¾ |
| September, . . . . | 30,073 | 11,213 | 1,064 | 4,047 | 10,549 | 7,338 | 740½ | 1,683 | 40,622 | 18,551 | 1,804½ | 5,730 |
| October, . . . . . . | 49,320 | 12,116 | 1,870¼ | 4,589 | 19,883 | 6,690 | 1,527¼ | 1,672 | 69,203 | 18,806 | 3,397½ | 6,261 |
| November, . . . . | 51,075 | 12,429 | 1,331½ | 5,783 | 23,943 | 9,635 | 921 | 1,764 | 75,018 | 22,064 | 2,252½ | 7,547 |
| December, . . . . | 45,493 | 13,823 | 837½ | 4,848 | 19,371 | 6,344½ | 1,226½ | 1,052¾ | 64,864 | 20,167½ | 2,064 | 5,900¾ |
| Totals, . . . . . | 617,338½ | 144,433 | 35,445 | 56,498 | 340,270½ | 83,461½ | 16,857¼ | 19,508 | 957,609 | 227,894½ | 52,302¼ | 76,006 |

## II.—REPORT ON SPANISH SARDINES. By W. Anderson Smith.

In the principal factory in Coruna we find in prominent letters the statement that the fisheries of Galicia maintain 50,000 families. According to Prince Albert de Monaco, at the present time 16,000 fishermen live by the sardine fishery alone: the same authority mentioning that, from Bayonne de Galice to Vivero, it maintains 400 salting and preserving factories. This is a proof of the exceptional abundance of the fish, as in the other Biscay provinces, such as Asturias and Santander, all the sardines captured are preserved in tins or otherwise, but not salted in bulk.

The absence of any important export of fish from Scotland to Spain, at this time, when Spain is yet unable to supply herself with more than 50 per cent. of her consumpt, made it important that we should have a better knowledge of the Spanish trade, and ascertain the reason why our salted herrings were practically shut out from the Spanish market. The reason given by our Consul at Coruna, that the conservative habits of the Gallego is against novelty, is only so far satisfactory that it demands that we give attention to the mode of preparation desiderated in the Spanish market. The Consul at Bilbao notes that the only buyers there of salted herrings, when introduced, have been the French and English residents; the Spaniards preferring their own cured sardines. Other consuls hold out more encouragement, but the question seems to us to be more one of mode of preparation, and consequently it is essential in the first place to know how the Spanish sardine is manipulated.

This Spanish sardine has become all the more important on account of the failure of the French sardine fishery for the last few years. In 1887, Spain, mainly Galicia, exported to France 1,323,413 kilos. What proportion of the export has been tinned and re-exported as French sardines, of late, it would be impossible to say. But no doubt the French have been obliged to resort to Spain to supply their deficiency in sardines as they have long done for their wines.

Before examining the Galician fishery more especially, we may glance at the whole sardine industry. This may be divided into two,—that of the Bay of Biscay and the Atlantic coast of Spain, and that of the Mediterranean. The two great labourers, scientifically, in these two fields are wholly at variance—amicably, and with a frankness which is an honour to science—as to the manner of the reproduction of their sardines; and indeed, they seem undecided whether the two fish may not be sufficiently differentiated to be widely different in their mode of life in the open and enclosed seas. The serious consequences of the departure of the sardine from those parts of the coast where factories are established, make the study of the movements of this fish and their causes to be of paramount importance. The better to grasp the problems to be solved, we may give them in the words of Professor Marion, in his comparison of Professor Pouchet's views with his own:—

'. . . For him, the sardine is a wholly erratic species, approaching the 'shore only accidentally, under what impulse is unknown, living 'commonly in the high seas, and even in regions the furthest from the 'coast, descending to the abysses of the ocean, reproducing itself there, far 'from the influence of man, and without regularity, or at least without 'being subject to the influence of the normal succession of the seasons. 'In fine, the egg of the sardine would *probably* fall to the bottom as soon 'as it is expelled. . . . . I do not, however, believe that (these supposi-

'tions) explain exactly the life of the sardine. What I have seen in the 'Mediterranean has led me to different views. . . . . The sardine is in 'the Mediterranean, as in the ocean, a nomadic fish, whose movements 'should necessarily be determined by the two great causes which govern 'the conduct of all other species, the constant search for food and the tem-'porary requirements of spawning. For in Mediterranean coasts, the 'sardine shows itself frequently and commonly on the surface. It can un-'doubtedly descend, either to avoid severe weather, or to gather the small 'creatures on which it lives, or for other causes. . . . . I may add that, 'in the Adriatic, it keeps itself usually at a certain depth, whence it must 'be attracted, as in the ocean, with a bait composed of broken-up *Car-'cinus mœnas*. . . . . I believe, indeed, that we may find banks of sar-'dines at a great distance from the shore; but I hesitate to admit not only 'that it lives usually on the high seas, for example between Algeria and 'France, in the centre of our Mediterranean basin, but even that it pene-'trates there regularly. . . . . In any case, and without wishing to 'deny that the sardine can make the crossing direct from the Algerian to 'the Provençal coasts, I do not admit that it proceeds far from the 'reach of man, nor in the offing, nor to great depths at a constant tem-'perature, in order to spawn. I think that the sardine throws its eggs 'near the shore, preferably in sheltered bays, and that the eggs are floating 'eggs like those of the majority of commercial (edible!) fishes.' There seems to us to be a distinct absence of certainty as to whether the two fishes treated of are the same or not. We are even disposed to question whether the same fish is always spoken of as the sardine even in the same district. Professor Marion seems to write of *Alosa sardina* (no authority) (see statistics of taxed fish on coast of Marseilles *), but in his monographs he does not give the scientific name. The same may be said of Pouchet, who only speaks of 'sardine.' Mr Cornish† says of the pilchard: 'It occurs, of course, off the French coasts as the sardine. 'And the Spaniards have a mode of curing it which altogether beats our 'English method, as may be seen by a comparison of our cured pilchards in this Exhibition with those in the Spanish division.' Dr Day seems to accept this identification of the pilchard and the sardine, in which Cuvier seems to have led the way. But Couch, who knew the pilchard better than most other naturalists can pretend to do, arrives at a different conclusion. Writing of a small catch, he says: 'In the year 1843 six hogs-'heads of (pilchards) taken, the fish about 6 inches long, and multitudes 'are so small as to pass through the meshes of the drift-nets. They are 'marked with spots along the sides, which grow faint and disappear as the 'colours fade. Compared with a pilchard of the same size I find the 'marking of the head different; the plate encircling the eye on its lower 'part and under being narrower, and gathered on the lower margin, where 'the pilchard is plain. The sardine appears to be the only fish of this 'family, except the pilchard, that has the dorsal fin at the centre of 'gravity.'‡ The Cornish fishermen who are in the habit of visiting the Galician coast seem to consider the large sardine as distinct, differing at least in certain seasons from the pilchard, and some we observed seemed smaller in the scale and more brilliantly marked when fresh, than the pilchard.§ In any case it would appear to be a local variety, as the sardine is often in best condition when the pilchard is out of condition.

* *Travaux de Zoologie Appliquée*, 1889 (*Station Zoologique d'Endoume*), p. 8.

† *Papers of the Conferences* (London, 1883).

‡ Couch's *History of the Fishes of the British Islands*, vol. iv. p. 112.

§ Yarrell says: 'They frequent the French coasts and are seen on those of Spain; 'but on neither in considerable numbers, or with much regularity.'

The immature sardines usually tinned have been considered sprats, and the term *Sprattus* applied to them, but Pouchet writes of the sprat in 1889:* 'This has made its appearance in prodigious quantities 'in the Bay of Douarnenez, where they have fished it with seines, 'which they tolerate for this fish, but throw every difficulty in the way of 'their use for the sardine. The sprat appears in enormous shoals, all of 'small fishes of an average of 80 mm. (the largest 90, the smallest 65), and 'weighing about 3 grammes. This fish, too small for the factory and to do 'up in tins like the sardine, has been sold by the barrel as manure. Cer'tain fishing boats combine for the seining, two and two, taking up to 50 'barrels daily. The weight of the barrel is from 160 to 170 kilos. 'This great destruction of fish has, as usual, called forth recriminations. 'Many small sardines are declared to be amongst the sprats. In a parcel 'of 47 of these fishes that I have received, and had certainly not been 'picked, not a single sardine was found. The hints given me by the 'Commissary of Marine Registration at Douarnenez confirm my 'observations as to this: "I am informed," he writes us, "as to the 'question you have put to me—the proportion of small herrings taken 'with the sprat is much less than I fancied; it is estimated at 1 per 10000 'at the most."' A few young herring in the same way are found amongst our sprats, only frequently to a far greater extent. Yet it is but comparatively recently that the sprat and herring have been clearly demonstrated to be distinct, and we doubt not the same uncertainty prevailed between the sardine and the sprat formerly in France. This makes it the more necessary that care should be taken in the definition of the particular species investigated, more especially as we learn from Couch that three separate species were known in the Mediterranean by the name of *Sardine*.

From the above quotation it is clear that it was the dimensions of the sprats taken, as too small for tinning, that alone prevented them being done up as sardines; and it is quite possible that the young of various species or varieties, as well as the smaller species themselves, may be tinned under the generic name of *Sardine*.

As to the sardine proper of the Atlantic coast, we are disposed to view it as differing from the pilchard to some small extent; while the pilchard at the same time occasionally visits the coast of Galicia, and a stray school of the mature sardine may reach the coast of Cornwall. But we cannot view the difference as greater than that found between the herrings of different Scottish lochs.

The fact that the sardine as usually tinned, however, is the immature fish of one of the herring tribe, points to the reason why it is superior for this purpose to a mature or comparatively mature fish like the sprat, whose bones are more calcareous, and less gelatinous. So that young herring of the same size would really be better fitted for competing with the tinned sardine trade than the sprat. But the sardine, as tinned, is more a question of size than of species, like our whitebait in all likelihood.† The great sardine fishery of Galicia, however, is quite a different matter, and may be considered as a duplicate of the pilchard fishery of Cornwall. Leaving aside the question of identity of species, both are fishes of some eight to ten inches long, both are captured close inshore at certain seasons with great seines, and both are specially treated for the southern markets. Mr

* *Rapport sur la Sardine.* Extracted from *Journal d'Anatomie et de Physiologie*, July–August 1889, p. 391. Note 2.

† J. T. Cunningham of Plymouth Laboratory informs me he has never found any sprats in sardine tins, but this is probably due to the greater care exercised in the higher class tinned fish sent to the English market.

Cornish in a note observes: 'There are two open barrels of the fish 'exhibited—one at each end of the westermost case in the Spanish Court. 'One is labelled "Pressed Sardines," and the other "Salted Sardines," but 'they are both of them pilchards, more cleanly cured than is our wont.' It is somewhat notable to find that the immature pilchard is now rare in Cornwall; while the sardine as it advances in size disappears from the French coast in the autumn just before the shoals of large pilchards appear on the Cornish coast at St Ives—October or November. At Concarneau M. Pouchet observed the sardine as fished from 31 March to 26 October when they seemed to keep advancing in size—say from 107 mm. to 190 and 217 mm.; but the progress was not constant, nor the shoals 'graded.' The ovaries were only found mature in the large sardine called transitory (*coureuse*) or (*Sardine de dérive*) drift herring. 'Un-'happily the continual change of place and final disappearance of the '"baited" sardine (*de rogue*) in the autumn deprives us of the principal 'data necessary to approach the interesting problem of the continuance of 'the growth, as well as the age of that which visits us in summer.'

The largest sardines at Concarneau were therefore from 8 to 9 inches in length, and these were what are named *Sardine de dérive: the Sardine de rogue*—that taken by baiting the nets, according to Pouchet—'is a young 'sardine which has never spawned at all, and which disappears from the 'French waters well before the maturity of its ovaries. It is further to 'be noted, that with the sardine the development of the testes or of 'the ovaries is very unequal, not only in individuals of the same size 'taken at different times during the season, but in individuals of different 'sizes taken at the same moment.'

The Mediterranean sardine does not seem to be quite so large. Marion writes: *—'From December to March, large specimens only are fished, 15 'to 16 cm. (under 6 inches). Rarely at the same period smaller fishes of '9 to 10 cm. are taken (under 4 inches). While the larger have their 'sexual organs in a mature condition, the smaller have only rudimentary 'reproductive organs. . . . . The bands which continue to pour in in 'April, May, June and even up to September, are always composed of 'large sardines; but from the month of July, troops of small fishes are 'added to the adults. These sardines, measuring scarcely 6 to 7 cm. (2¾ 'inches), soon occupy the whole gulf. In October, when the fishery is 'resumed, these same individuals reach 9 to 10 cm. They remain in winter 'alongside the others, but notably less numerous.'

Again he remarks: †—'In April and in the first days of May, bands 'of Alevins, identical with the *Nonnats* of Nice, 3 to 4 cm. (1½ inch), show 'themselves in quantity in the Gulf of Marseilles, and are killed in con-'siderable numbers by the net called *mugeliero.* It is reasonable to 'suppose that these same *Nonnats* of April become the little sardines of '6 to 7 cm. (over 2¼ inch) in July, increasing until they almost reach the 'adult size in November. These yearlings develop alongside large 'sardines of 15 to 16 cm. (6 inches) which represent an older generation. 'From the first days of November, the ovaries of these larger fishes are 'full of well developed ova, measuring 0·7 mm. to 0·9 mm. The 'testes are at the same time in a state of repletion. There is, at the 'same time established a sufficiently great inequality of sexual maturity 'between the various individuals examined, which shows us that they do 'not all deposit their spawn exactly at the same period. This state of 'the sexual glands continues to the end of February. I have sometimes

* Marion, 22nd May 1888. 'La Sardine sur les côtes de Marseilles' *Comptes rendus des séances de l'Académie des Sciences*, t. cvi., p. 2.

† M. A. F. Marion, *loc. cit.*

'seen in March, from the 1st to the 6th, females whose ovaries were 'manifestly emptied, but which, at the same time, contained still some 'large ova measuring 1 mm.' M. Marion concludes that the sardine spawns from October to March, but never in the summer months, that its ova are pelagic as are those of the anchovy, that although not *proved*, still in combination with the observations of Dr Raffaele at Naples, he looks upon the evidence as incontestible. He also desires to control, if not altogether stop, the destruction of Alevins at present carried on without hindrance on all the littoral of the south of France.

There is an essential difference between the views of M. Pouchet and M. Marion. Both note the irregularity of condition as to sexual maturity, both have two classes of sardines of different sizes—the one immature—the other ripe or ripening. But in the case of the Mediterranean fish the ova are apparently thrown before the fish leaves the coast, while M. Pouchet finds no evidence of the fish spawning until they leave in a ripe condition (the *Sardines de dérive*). At least, he remarks that* 'the sardines ready 'to spawn, regularly show themselves on our coasts, mostly during the 'months of *April and May:* that he has never found eggs of the sardine 'in the sea at Concarneau, although his attention was specially called to 'this point; and finally, that they never meet on the oceanic coast the 'young sardine called "poutine" in the Mediterranean.' All these facts point to the pelagic character of the sardine in his view, and that the first months of its existence are passed in the unknown regions of the Atlantic. He looks upon those sardines that come in during the winter as stragglers and strayed, leaving behind the regularly defined migrations.

The smallest sardine that showed mature ova to Pouchet was 193 mm., say $7\frac{5}{8}$ inches, much longer than the mature fishes of the Mediterranean. This, too, when the Mediterranean sardine spawns from *October to March*, while that of Concarneau is only found mature in *April and May.* Again the Prince of Monaco in his admirable Monograph of the Sardine on the Coasts of Galicia says, 'Towards the month of *December*, it will confide its 'ova to the herbage which carpets the bottom, and it will then make an 'excursion into the profound depths which are in the vicinity.' The Prince gives us no reasons for this belief, and is evidently imbued with the ideas of Pouchet on the subject, as to the eggs being demersal.

The pilchard spawns at the same time as the sardine according to Couch, 'in *April and May* they are habitually prepared to shed their 'spawn, which they now do at a further distance from land, and even 'deeper water than is the case at the warmer season of autumn, when 'again, early or later, they perform the same function'—October—'the 'season of spawning *after the Equinox.*'

Let us leave aside the Mediterranean sardine, and consider the Galician which spawns, according to the Prince of Monaco, *at the bottom* in December, and is there called 'the pilchard;' the Concarneau sardine which is only found mature in *April and May;* and the Cornish pilchard which is mature and ready to spawn also in *April and May*, as well as in the autumn. The sardine of Concarneau, according to Pouchet, must spawn on the bottom and in deep water, as its eggs are never found by him on the *surface* at the time when the fish are ripe. The pilchard of Cornwall spawns, according to Couch, on the *surface* in great glutinous masses—which ought surely to be readily seen if thrown near Con-

We know that the herring—a closely allied fish to the pilchard—spawns at the *bottom* in glutinous masses, while the egg of the *sprat*, also

* Pouchet, *Extrait du Journal d'Anatomie et de Physiologie*, No. de Nov. Dec. 1890.

a closely allied fish, seems to be pelagic. Professor M'Intosh's statement on the subject is as follows:—

'The eggs of the sprat appear from St Andrew's Bay and the Forth in 'March and May. They are very frequently met with in April and May, '*and often in the bottom net in profusion.*' * The Italics are ours.

Now this is the same spawning season as the sardine, *April and May*, and the 'pelagic' ova of this fish are found *in the bottom net in profusion.* Is there here an explanation of the difference of opinion as to their deposition, and their absence from the surface nets at Concarneau? We want more light on this matter. As while specific gravity may affect them in St Andrews Bay and the Forth, it cannot do so in the Bay of Biscay?

Meantime we have the opposing views of those who fancy that:

1. '*The sardine comes from the North to the South.* The fishermen of 'Coruna say that between July and September the sardine enters the 'bays in quantity with the wind to the north-east which causes a current 'on the coast towards the north, and this tendency to shelter itself against 'an impulse towards the north, agrees with the above old established 'opinion.

2. '*That the sardine proceeds from the South to the North.* This view 'is based on the fact that the sardine fished in Biscay, towards the com'mencement of spring, could not visit England until the autumn, when 'much larger.

3. 'To-day certain fishermen in Galicia believe that the sardine comes 'from outside, and some captains declare they have seen it about 15 miles 'from the land.' †

That there is a remarkable, if not absolute, similarity of species between the sardine and the pilchard no one can now well doubt. But we do doubt most emphatically that either the sardine of Galicia or of Concarneau belongs to the same shoals as the pilchards of Cornwall, or those of the south-east of Ireland. The probability is that all are shoals of varieties of the same species depending upon locality and food for the slight variation.

The great depths of the Rios of Galicia, or close by, are given as reason for the constant regard of the sardine for the district. While other regions have been subjected to their intermitted attentions, Galicia has never failed of their attendance. The idea seems to be that the fish retire to these depths to escape from turbulent waters, or to reach a milder temperature. But the experiments and observations of Pouchet do not seem to have given any support to the temperature theory, as neither the prevalence of the fish themselves, nor of their food, seem to be regulated by thermometrical readings.‡

The great probability is, however, reasoning from analogy, that the sardine of Galicia, although closely resembling the Cornish pilchard, is *local.* It is extremely delicate in its mature condition, and of particularly fine flavour; and although we cannot say the same of the Galician tins of small sardines, compared with the French, the likelihood is these are injured by lack of skill and care in the preparation. For the tinning of sardines is a quite recent industry compared with the preserving of the matured fish in Galicia; and even on the Biscay coast of France, the quality is, and has always been, most irregular, and largely dependent upon the district and the character of the ground.

The conditions of these 'tinnable' sardines, which are young fish 'on the feed,' and largely attracted by the use of cod roe as bait—

* *Eighth Annual Report*, p. 284. † Prince de Monaco, *op. cit.*, pp. 4–5.

‡ 'The action of the temperature is not clearly appreciable, and the effects that 'one might attribute to it, are easily attributable to other causes acting at the same 'time. The same remark applies to the *light.*'—Pouchet.

'*Sardine de rogue*,'—must be dependent upon their food, and it would seem thus that: 'at Concarneau, there are (stomach contents), according 'to the season, copepoda, embryos and eggs of small crustacea, annelids, 'infusoria, radiolaria, everywhere low class plants, such as diatomacea.' The special interest attaching to the viscera collected in Galicia consists in the enormous quantity of infusoria which were found in them. 'According to the calculation of two assistants, the contents of one of the 'intestines (not including the œsophagus, the stomach, and its *cul de sac*), 'might be taken as twenty millions of peridinea of a single species '(*Peridinium polyedricum*, Pouchet).' *

We have unfortunately not such a series of investigations into the sardines of Galicia as into those of France, nor have we sufficient knowledge of the temperatures and bathymetrical data from which to draw conclusions. But the variety of temperatures, owing to the great depths outside, and the gulf stream closely impinging upon the Galician coast, enabling the fishes which are delicate to escape from unsuitable conditions within a very short distance, must have some influence.

The principal fishery under the Cornish system, of great seines for enclosing, and small tuck seines for capturing afterwards, we were unable to see in its full strength in Coruna. Indeed, this fishery must be considered to be in its decline, and scarcely suitable for the modern conditions of the Bay of Coruna, at the very head of which it was carried on. The fishery could only be conducted when the shoals of sardines had reached the inner portion of the bay where the depth was suitable for the nets employed, and this naturally would only take place where they were not broken up on the way thither. But of recent years the bay seems to have become much more frequented by steamers, and whether from this cause or some other more natural, the great shoals seem to have ceased entering to the proper position. The result of this is, that in place of nine factories as hitherto, this year all have ceased operations but two—being those of wealthy firms of old standing, capable of tiding over a few years of depression. These establishments, both of which we visited, and of which we saw the equipments, are very large, and the mode of conducting the business is such as to require very large captures of fish to suitably remunerate the investors. The main seines are very extensive, piled up in huge barges, manned by crews of men paid partly by wage, partly by share in the produce. They are said in Coruna to hang about the public houses waiting for the order to embark, and to be of no very good type; but they seemed to us fairly stout, and well-clad men, of by no means a bad type. About five in the evening, they may be seen embarking on the barges moored off the factories, with the nets on board, and rowing off for the fishing ground, where they watch all night. The best portion of the bay is buoyed off into four portions where the seines can be handled satisfactorily, and the owners of the factories have the right to draw the seine on these time about. Now that they have been reduced to two, the difficulty of arranging is greatly reduced, and all the vessels (barges and boats) go off together to the fishing ground. The barges may be seen moored during the day with the net under a covering. The main barges contain the seine net, the reserve seine, and the tuck seine separately; smaller vessels carry the equipment—such as the hauling ropes each nearly a mile and a half in length,—and are afterwards employed to carry ashore the catch.

When the fish are sighted the great seines are set as on our own coast, the tow ropes carried ashore to the capstans up the beach, and when the fish are properly surrounded the nets are anchored, and the fish sometimes kept in them with a cordon of boats around for a week or two, until the

* Prince Albert de Monaco, *op. cit.*, p. 7.

contents are steadily worked off in the factories; but this does not often happen now. The seines are corked above, but not leaded below for fear of injury to the bottom and the life there, the net being kept down with a triple ply of ropes. The great seine is 650 yards long and 33 deep. The meshes of the wings, which are detached when the net is enclosed around the fish and the supplementary portion added, is $0{\cdot}030^{m}$. that of the centre $0{\cdot}015^{m}$. The object is to allow the small fish to escape during the operation which takes some 10 or 12 hours to complete.

The quantities taken formerly on these occasions are almost incredible. One of these large seines can enclose, and the factory work off, 39 barges of fish, each load worth £500, and altogether containing 5 million fish. These are thrown into 70 stone troughs of great size, in two long ranges up the factory—the surface on a level with the floor nearly—for convenience, and covered with heavy wooden lids. These are carefully made to hold upwards of 50,000 fish each. The fish are salted in layers as they are placed in the stone vats, and left there for some time, according to pressure in the factory—generally 15 days. A great amount of space is required for such an extensive establishment, and the capital invested in the principal factory is not less than £12,000, idle except during the sardine fishing. The fish having been delivered from the barges on two sides of the factory are turned over with shovels, and salted with seived salt, ere being consigned to the stone vats. Taken from thence they are skewered in twenties, undergo four washings, and are then ready for the barrels. It must be well understood that these sardines are not the immature fish that are tinned, but fish up to 7 inches long that are prepared for keeping in hot weather, and consequently are better suited for the Spanish and Mediterranean markets than our ordinary Scotch herring. While the sardine is commonly left for a fortnight in the stone tanks covered with salt, the pilchard of Cornwall is often three months or more in salted heaps ere being finally treated for the Italian market.

After being washed as above the sardines are laid in the barrels and piled up until they reach, according to the size of the barrels, from 7 inches to perhaps a foot above the top of the barrels. On the surface of this a lid like a daunt is placed, and the barrels set in rows under a series of levers formed of long beams of wood. One end of the beam is fixed to the floor—several systems being employed—and the other end is weighted by a heavy stone with a ring attached. The lever in its lower length crosses the top of the barrel and brings a steady pressure to bear upon it, with the result that the oil is slowly expelled along with the surplus brine. This runs along a channel in the stone floor to the far end of the long shed, where it is received in a system of tanks. The first tank holds say 3 hogsheads of the combined liquor, from the upper portion of which the higher stratum (of pure oil) flows over into the oil tank. From the *bottom* of the first tank the heavy brine runs away, the division thus taking place automatically. There is a great difference in the quantity of oil taken from the summer and winter fish, as might be expected, the summer sardine supplies a barrel of oil to every 24,000, while in the winter months 300,000 fish are required to supply the same quantity. From time to time the barrels are examined, the weights increased and the pressure maintained until the proper quantity of fish is pressed down into the receptacle. The smallest keg is 24 hours under the press, with additional leverage or weights every few hours. No other system is so good as this leverage one. Screw presses have been introduced into Cornwall for the pilchard fishery, but the pressure is not so equal and steady, but only increased by spurts in place of continuously following the depression of the fish in the barrel as is the case with the levers. The barrels are markedly distinct

from those of Scotland used for herring. They are specially made somewhat open to permit the escape of the brine and the oil. They are broader, squatter and have a greater range of sizes; while, owing to the absence of any necessity for being absolutely water-tight, they are of inferior manufacture generally to our well-made barrels. While this openness in the barrel is undoubtedly useful for the purpose intended, it is not advantageous when it goes into the market, as the air gets more readily even at the best-packed fish, and cannot fail to facilitate putrefaction. We believe that well-packed, well-cured Scotch herring of medium size would compete satisfactorily with those Spanish fish, and yet these latter are too small to enter into competition with our own in our principal markets.

These Spanish barrels are of various sizes, and it may be of some utility to know exactly what these are, so that the custom of the country may be so far met by the merchants who may wish to take advantage of the Spanish market. The sizes are:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1st, | 20 in. deep, | 2 ft. | 2 in. diameter, | holding | 262 | kilos. |
| 2nd, | 15 ,, | 2 | 2 ,, | ,, | 196 | ,, |
| 3rd, | $11\frac{1}{4}$ ,, | 1 | 8 ,, | ,, | 70 | ,, |
| 4th, | 7 ,, | 1 | 8 ,, | ,, | 45 | ,, |
| 5th, | $6\frac{3}{4}$ ,, | 1 | 4 ,, | ,, | 24 | ,, |

The prices of course vary with the season, but when No. 4 contains 1000 fish it fetches roughly 16 pesetas, and if containing 1300 fish—it brings 12 pesetas or 10s. Sterling.

While there are distinct advantages in the Spanish mode of packing, requiring less skill in the making of barrels, less space, consequently saving cost of transit, and less weight, as the brine and the oil are removed, yet the counterbalancing disadvantages are also evident. Thus the open chinks admit air and do away with much of the advantage of close packing; the absence of brine demands heavy previous salting; and the fish have neither the appearance nor the fresh smack of our own best-cured fish. At the same time the same class of fish as that for the Baltic would require better salting for the Spanish market, and it is probable that mattie herring would, on the whole, be better suited for this market than the larger classes.

The largest casks are called 2 to a pipe—next 3 to a pipe, while the smallest tubs are for America.

Sometimes for special markets they are not pressed, but put in tight barrels: even then however, the barrels are not *headed*, but only covered. The firm of Maristany Brothers, Coruna, alone can press 300,000 fish at one time. The establishments in general are well-aired and very extensive, so as to push through a heavy fishing.

Besides the large full-grown sardines this firm prepares the small fish in tins, which sell at 40 pesetas per 100, or 4d. each wholesale. The Noya factory sells a smaller tin wholesale at 2d. each; but either the oil used, or the mode of preparation of the latter was distinctly inferior to that of the French. We cannot believe that the fish are inferior in any way, as all we partook of were remarkable for delicacy of flavour.

It is now practically accepted that the pilchard and sardine are *de facto* the same species, nor can we note any *specific* difference between them as taken simultaneously off Coruna and off Looe in Cornwall. The discussion that has arisen as to the pelagic or demersal character of the ova of the sardine must be consideredin the latest light of the investigations made by Mr Cunningham at Plymouth, for we have no reason to separate the sardine from the pilchard in this connection. In 'Reproduction and Development of Teleostean Fishes,' Mr Cunningham found the pilchards' eggs to float on expulsion. He found the pilchard to spawn far out at sea,—some 20

or 30 miles—the spawning or ripe fish never being taken inshore as in the case of the herring; but only 'immature or shotten fish on the feed.' So Cornish: 'before our pilchard season commences, numerous shoals of very 'large pilchards are met with by our mackerel drivers in the deep sea, 8 'leagues and over south and west of the Scilly Isles. These large pilchards 'are mostly females full of roe ready to be shed and unlike most fish in 'that condition are so dry and tasteless as to be utterly useless as food.'*

These ova compare exactly with Raffaele's figures, considered by him to be pilchard. They could not possibly be herring ova, which are demersal. They could not be anchovys' ova these being spherical in shape. They could not be sprat ova, as these have not an oil globule. All these considerations led Mr Cunningham to support the view of Marion that the pilchard ova were pelagic. Since then he has hatched out the ova and carried the larva to the same stage as those taken in the tow-net. So that we may now accept it as assured that the pilchard ova, like that of the anchovy and sprat, are pelagic, and thus differ entirely from the herring, otherwise so closely allied to all three. One objection to the reasoning of M. Pouchet is his apparent disregard of the fact that the ripe ova of some fishes when expelled or before expulsion increase in size, and consequently decrease in specific gravity, so that the placing of imperfectly ripe ova in the water is no test of their conduct under natural conditions. In any case, Cunningham's recent observations seem to have placed the pelagic character of the pilchard ova beyond question.

This may seem a matter of little commercial importance, and yet it is probably of vital consequence to the fisheries of the Biscay coast. The fact that these fishes do not come inshore when they are spawning, but remain outside beyond the influence of the ordinary attack of the fishermen, has probably secured to the Spanish coast its lengthened career as a great fishing region. Although very small fishes are now taken in some quantity, the great fishery has been one of fishes that have neither milt nor roe, but are either shotten or immature as in the case of the Cornish pilchard. What specially attracts them inshore at those seasons has not apparently been clearly ascertained, unless it is the wealth of infusoria as noted. Another view openly held by Spanish authorities is that the Dolphins outside drive the larger shoals into the bays.

In any case a multitude of these fishes come inshore at the same time every year around the Galician coast. They appear, too, at the same period on the coast of West Cornwall, and it would seem as if, for our herring to get a hold in the same markets, they must be superior to the opposing article. For in Cornwall their market is glutted for the pilchard. We are told: 'Spain is running us so close in the business of 'supplying salted pilchards for the markets of the Roman Catholic 'countries, that we could easily find thirty to forty millions of fish for the 'supply of a fresh fish market without feeling the loss of them. This 'apparently enormous number would be a mere flea-bite out of our catch for a season. It would be a day's, or at most two days' successful 'fishing for the seines of St Ive's alone.' † The same writer has told us the Cornish cure is inferior to the Spanish; but since then Italians have entered into the business in Cornwall on a large scale, to prepare the fish specially to suit their own markets.

The attempt to introduce the tinning of the small sardine in Cornwall has proved, we understand, a commercial failure, although no reason except, perhaps, the difficulty of getting the finest oil sufficiently fresh, presents itself to us.

* *Papers of the Conferences*, p. 29.

† Cornish, *Papers of the Conferences*, London, 1883.

The sardine, whether in Cornwall or Galicia, or the Biscay coast of France, while never quite deserting the region, has shown all the uncertainty of the herring. But the reason for its movements given by Mr Cornish is quite in support of our views so long persisted in, as to the local character of the herring. The pilchard, he considers, like the herring, is not properly migratory, but merely moves seaward and shoreward according to season. But if the young are taken wholesale, year after year, as on the French coast, they must perforce get fished down to a degree that only an exceptionally favourable season or seasons can recover them from. No doubt, modification of currents, temperature, and salinity within the Bay of Biscay may influence the French catch, in a way that the Galician can scarcely be influenced, impinging as it does directly on the outer Atlantic. But human agency, by the destruction of the young in myriads, must have a very great deal to do with the scarcity. Fortunately, the poor condition and valueless character of the ripe sardine of mature size will prove a certain security; while the difficulty of getting a market for an indefinite quantity of the tinned article will prove an additional commercial safeguard.

As it is, the fine large Scotch herring, thoroughly well-cured and well-packed in sound barrels, to meet the Spanish market, if properly introduced, should find itself without any real competitor. But it must stand carriage and keep through the hot weather.

We may here also allude to the decay of our trade with Spain in dried cod-fish, which under the name of *bacalao* was long an important export from this country. It has been almost entirely replaced by the poor Norwegian article from the Lofodens. These, too, are sold as Scotch, *Bacalao de Escocia*, which is always asked for by the conservative people of these lands. It is, therefore, not a new conquest, but the regaining of an old market that is wanted, and to do this our fish must be more carefully prepared for the market. For, although it is acknowledged that our fish are far superior for immediate use, they do not keep like the hard dry Norwegian article, which stands the heat and moisture better than ours. We require to choose proper fish—the agreeably flavoured but soft article from Barra will not do—and to salt them with proper salt, as well as dry them better than we do now, when they are never under cover, and are subjected to the constant damp of some districts in the West. If dried properly under the very simplest sheds the fish would keep better. The salt employed is also a matter of consequence; those cured with Bay salt are commonly condemned from being covered with 'red spots.' * The Spaniards require far more fish than even their prolific coasts supply, and if we could place a proportion of our herring catch in their market, in suitable condition, at a reasonable price, we might ease the Baltic markets, and improve our position at home. We can supply the finest fish and the best-cured fish of any country in the world, and it remains with our merchants to see that they are not thrown away through negligence, or ignorance of the conditions of the markets to be supplied. Our herrings have no equal, and in place of being hurled *en masse* into one or two markets, they should be judiciously divided amongst foreign markets, and made the most of. At present we have all our eggs in one basket, and one not difficult to upset. And it was mainly that an opening should be sought in this great Roman Catholic fish-eating country, that we undertook the mission of ascertaining exactly how the Spanish fish was made up for the native consumer. They are made up to *keep* and to *carry*. Fish that will not keep in that climate are of no value to them.

* See our article on Curing Salt in last year's Report.

## III.—ON OVER-FISHING OF THE SEA AND THE CULTURE OF SEA FISH. By Dr T. Wemyss Fulton, F.R.S.E., Secretary for Scientific Investigations. (Plates III., IV.).

### I. Introductory.

Probably the most fundamental and important question in connection with sea fisheries—especially those prosecuted assiduously in an area comparatively confined, such as the North Sea—which minister to the needs of large populations rapidly augmenting in numbers, wealth, and means of intercommunication, is this: Are these fisheries capable of expansion, *pari passu*, with the necessities of the people? Can the supply of food derived from the sea continue, unaided, to meet the ever-increasing demand? The question has been answered Yea and Nay on many occasions; it has been the basis, expressed or implied, of several Royal Commissions, and it has inspired much fishery legislation, one way or the other, according to the views held at the time. In regard to the other great sources of food supply, no such question need be asked: mankind since prehistoric times has depended for its bread and its beef upon profound interference with natural conditions.

Concerning the food supply obtained from the sea, it is admitted on all hands that the fisheries for shell-fish—oysters, mussels, cockles, clams, &c., which partake of a terrestrial character, can be, and have in many places been, exhausted or destroyed by the operations of man. The same is true with the fisheries for ambulatory shell-fish, such as lobsters and crabs, whose distribution is confined to a limited zone around the coasts. But there is by no means the same agreement respecting the fishings in the open sea. It has been contended by the most eminent authorities that the sea cannot be overfished. The destructive influences which man can bring to bear upon fish life, they say, are infinitesimal when compared with the great reproductive capacity of sea fishes, and the destructive forces of nature as manifested in the action of physical laws and the perpetual strife of organism against organism; that the sea, in short, is a storehouse of food material, the resources of which are practically unlimited and inexhaustible. The doctrine of this school may be summed up in the following opinion of the celebrated naturalist, Van Beneden, its most eminent exponent on the Continent. 'The fecundity 'of fish,' he says, 'is so great, the quantity of immature fish destroyed 'is so small in comparison with the immensity of the sea, that it does 'not matter where or when the fishery is carried on, or with what 'engines, man is unable to disturb the equilibrium which the Creator 'has established between destruction and reproduction—between life 'and death.'

On the other hand, authorities of equal eminence declare, and their declarations gather force with the progress of statistical and scientific enquiries, not only that over-fishing in the sea is possible, but that it has occurred, and is going on now in connection with certain fisheries and certain areas.

In this country the subject may be said to have passed through three phases or periods, to each of which I may briefly refer. Up to about thirty years ago it was but little questioned that over-fishing could occur. Hence the general practice was to regulate fisheries, not merely from the police point of view, but in relation to the instruments of capture, the

size of the fish, the locality, &c. The second period began between 1850 and 1860, although symptoms of its advent may be traced many years earlier, and it culminated in the removal of all restrictions on white fishing in the sea. The third period is recent and began only a few years ago, and is characterised by recurrence to the practice of the first period—restriction and regulation.

With respect to the first period, which began in the dawn of history, I may say that there is very little evidence in the earlier records relating to the sea fisheries of Scotland of complaints as to over-fishing or the regulation of the mode of fishing. The Scottish fisheries in past centuries suffered great fluctuations. There were periods of prosperity—probably greater, comparatively, than any witnessed now—and of depression or practical suspension. But these changes were associated mainly with domestic peace or with the civil and warlike troubles of the times—the prolonged struggle for independence, the ravages of 'our auld enemies of England' especially in the times of Henry VIII. and Elizabeth, the paralysis following the overthrow of Charles I. and the ascendency of Cromwell, the rebellions of last century, and so forth. All these national disturbances and calamities profoundly affected the prosperity of the fisheries, especially on the East Coast. Hence, in the Acts of the Scottish Parliaments we fail to discover evidence of interference on the grounds stated, although such Acts are not uncommon in the old Parliaments of England—*e.g.*, 13 Richard II., c. 19 (1389–90); Henry VII., c. 21 (1488–89); 1 Elizabeth, c. 17 (1558–59; 3 James I., c. 12 (1605), &c. There are a considerable number of Acts in the Scottish Parliaments, and in the even more ancient burghal laws and regulations, relating to the sea fisheries, but they refer to other matters. Nevertheless, evidence of interference is not quite absent. In mediæval times the powers of the Scottish burghs—trading corporations and communities—like those of the Hanseatic League on the Continent were very great, and these burghs exercised an authority over the fisheries which at the present day could be exercised by the Imperial Parliament alone. At the beginning of the seventeenth century complaints were made of the injurious action of the 'sandeill polkis' (bag-nets) in certain estuaries, which it was alleged caused 'grit distructioun of the hering 'fry, werray hurtfull and preiudicial to the fisching of hering, and sua 'hurtfull to the haill estait of merchandis'; and the same mode of fishing was subsequently interdicted for other reasons elsewhere. Interference with the mode of fishing had, however, reference almost exclusively to the herring fishing, and need not be here discussed. I may, however, refer to one case, which has interest at the present time. In 1632 King Charles I., who was constantly inspired by an emulation of the Dutch, and profoundly desirous of making the fisheries handmaiden to the navy, wrote as follows to the Council in Scotland concerning the famous herring fishing on the Ballantrae Bank:—'Whereas we ar in'formed that the fishing of Ballintrea doeth verie muche hinder the 'plenty of herring fishing in the west coasts of that our kingdome and 'yles thairof, and those parts of Ireland opposite thereunto, by destroying 'the fry of herrings at unseasonable times, whiche (as we ar informed) if 'they wer spared might produce suche plentie in all these coasts as might 'verie muche advance the intended works of fishing now established by 'us for the generall good of all our dominiouns, and speciallie of those 'parts. Thairfoir our pleasure is that yow caus proclamatioun to be 'made discharging the unseasonable fishing thereof in all tyme comming;' and sureties for the observance of this prohibition were to be taken from those accustomed to fish on the Ballantrae Bank. This herring spawning ground has formed the subject of legislation more recently, and on much the same grounds as in the time of Charles; and yet we are to

this day ignorant of the migratory movements of the herrings which frequent it.*

Subsequent to the Union of Scotland and England a great number of Fishery Acts were passed, and some of these deal with the question of over-fishing or mode of fishing. In the reign of Anne and in the reign of the Georges, such legislation found its way to the Statute Book. In some cases these Acts were local, or did not apply to Scotland, and when they did apply to Scotland, they referred almost, but not quite, exclusively to the herring fishery, which then as now was the most important. Certain conspicuous examples may be found in the present century.

Such, then, was the general nature of legislation affecting this subject until about thirty-five years ago, when the second phase or period began. It was characterised by the prevalence of a liberalising and liberating spirit and the removal of restrictions. This movement, associated in Great Britain with the names of Huxley, Shaw-Lefevre, Caird, Lyon-Playfair, Walpole, and Buckland, undoubtedly originated in the reforms flowing from the doctrines of Cobden and Bright, and was in complete accord with the commercial and industrial spirit of the times. It was connected with important contemporary inquiries into the condition of the fisheries; but it is easy to trace in the official publications the operation of the influence referred to. It underlay many of the questions asked, and gave colour to the conclusions drawn from the evidence obtained. It may at once be said that the removal of restrictions was the only logical course at that time, by reason of the almost complete absence of statistical and scientific knowledge of fisheries; but the progress of the movement, no doubt, was accelerated by the unhappy consequences of certain legislation affecting the Scottish herring fishery—legislation founded mainly upon such hypothetic views as we have seen to be reflected in the mind of King Charles more than two centuries before.

It is noteworthy that this liberating movement was not confined to this country. In Holland, where for centuries the fisheries had been subjected to the most minute regulation and supervision, the revolt broke out even earlier than in England. The public mind was not only prepared for the change, but demanded it. Fierce and protracted debates occurred in the legislature, and pictures of Dantesque gloom were conjured up of what might happen if the fabric of legislation, under which, it was said, the great fisheries had elevated the nation to a pitch of unexampled prosperity, was sapped. Nevertheless, a Royal Commission was appointed in 1854—one of the most important of recent times—to determine whether the existing sea fishery laws should be repealed *in toto*, or whether any of them should be retained; and, as a result, sweeping reforms were subsequently made. One recommendation of this Commission was that every one should be left free to fish where, when, and how he found most convenient—a doctrine subsequently repeated in Huxley's aphorism to fish 'where you like, when you like, and as you like.' In Belgium also, in 1865, a Royal Commission was appointed, which reported strongly against interference either as to time, place, or mode of sea fishing.

In this country several Commissions or Committees of Enquiry recommended in the same sense, the earliest of which were connected with the Scotch Fisheries. The great Commission of 1863–66 went very exhaustively into the subject, and apparently found no trustworthy evidence of over-fishing; and they recommended 'that all Acts of Parliament which profess to regulate or restrict the mode of fishing pursued

* The Fishery Board have recently authorised an investigation to be made on the migrations of the herring, and experiments on those visiting the Ballantrae Bank were begun by the writer during the spring of the present year (1892).

'in the open sea be repealed, and that unrestricted freedom of fishing be 'permitted hereafter.' This was done by the Act of 1868.

The Commissioners appointed in 1878 (Buckland and Walpole) also stated, 'There was no evidence that the supply of fish generally on the 'coasts of England and Wales is decreas-ing; and in those cases in which 'the supply is decreasing, there is no evidence that the decrease is due 'to wasteful fishing or over-fishing.' They seem to have allowed that there was a falling off in flat fish in some places. In the report of the last great Commission (consisting of the Earl of Dalhousie, the Right Hon. Edward Marjoribanks, M.P., Mr W. S. Caine, M.P., Sir Thomas F. Brady, and Professor Huxley, the latter of whom did not, however, sign the Report) it is distinctly admitted that over-fishing had occurred. They say: 'After carefully considering the whole evidence upon the 'question of the decrease of fish, we are of opinion that, as regards 'territorial waters—(I.) On many fishing grounds, from the Moray Firth 'to Grimsby, there has been a falling off in the takes of flat fish, both 'as regards quantity and quality. (II.) There has also been a decrease 'in the takes of haddock in certain places, chiefly in bays and estuaries. 'As regards offshore waters (III.) No decrease, except in the case of 'soles, has been proved in the total takes of the North Sea.'

The third phase or period to which I have adverted began immediately subsequent to the Report of this Commission. Both in this country and on the Continent restriction has again come into play, and all around the North Sea complaints are loud as to a falling off in the supplies of certain fish. This is the case also in Spain and Italy and elsewhere. It cannot be said that this recrudescence of restriction was the result of definite information, ascertained by sufficient statistical or scientific inquiries. In its initiation it had the same illogical basis as the legislation prior to 1868. Nevertheless, within the past few years, a certain amount of definite knowledge has come to the surface, particularly in relation to the North Sea Fisheries, which leaves no room for doubt that over-fishing has occurred, and is going on to a serious extent.

And this fact, based upon statistical and scientific evidence, seems to me of profound importance—the most important, indeed, which has emerged during the present century in connection with sea fisheries. It shows that the influential opinions of the last generation as to the inexhaustible resources of the sea were greatly exaggerated, and that with rapidly augmenting populations around the North Sea, and a vast increase in the extent and efficiency of the machinery of fishing, we are face to face with a new phase of the question. Sooner or later, this new condition will lead, I believe, to international convention, not merely as hitherto for the police regulation of the fisheries, but for the conjoint protection and conservation of the fishing grounds; and also to the organisation of sea fish culture on a large scale.

From the point of view ennunciated, I give in the following pages a result of a study of the statistics of the Scottish Sea Fisheries since the beginning of the century.

## 2. The Statistics of the Scottish Sea Fisheries since 1809.

When the Board of British White Herring Fishery was established in 1809 to supervise the cure and packing of white herrings, they took over duties previously performed by the Customs, and the statistics collected related exclusively to the administration of the Acts on the Herring Fishery. Officers were to be placed 'where herrings are caught or cured, 'and at the ports or places where vessels are usually fitted out for the

'British herring fishery, and where vessels employed in the said fishery 'usually discharge their cargoes, and also at the ports of exportation.' Seven officers were appointed on the West Coast and three on the East Coast, an additional officer being placed at the port of Yarmouth. Three things must be kept in view from the outset:—(1), that the statistics were based upon the bounty system, then in force (from which, indeed, our fishery statistics have sprung), and not at all upon economic grounds; (2), that they related to England as well as to Scotland; and (3), that they were for a long period confined to those points connected with cured herring. In 1820 bounties began to be given for cured cod and ling, and statistics were accordingly collected referring to this branch of the industry, and have been continued since. Statistical returns from England ceased at the end of 1849, and those from the Isle of Man at the end of 1868, since which year the tables published in the Annual Reports refer to Scotland alone. I have, however, gone over all the returns up to 1868, and deducted therefrom everything that related to England or the Isle of Man, so that in the tables given below the figures refer exclusively to the Scottish fisheries.

In the earlier reports the statistics, besides dealing with the herrings cured and exported, supply information as to the number and tonnage of busses or vessels fitted out, the number of men composing the crews, &c., and also the square area of netting carried and the quantity of fish landed. But inasmuch as these vessels—even those fishing on the bounty system—purchased their fish at various parts of the coast, no trustworthy comparison can be made between the apparatus of capture and the quantity of fish caught. At this time no information whatever was given as to the fisheries generally—the number of men, boats, &c., engaged—although fish caught by 'open boats' are included in some of the returns. It was not until 1825—five years prior to the extinction of the bounty system—that statistics were given showing the number of men and boats employed in the 'shore curing herring, and cod, and ling fisheries.' This was when Mr James Dunsmure was Secretary. In 1843–44 an important reform was made in the fishery statistics, Sir Thomas Dick-Lauder being then Secretary: the tonnage of the boats was now first given, and at this time the *value* of the boats and fishing gear was first included. The quantities of herring, and cod, and ling consumed fresh, 'so far as could be ascertained,' were stated, and a special feature in these new statistics was that the extent of netting used in the herring fishery and the length of lines used in the cod and ling fishery were also given. These statistics were published annually until 1857, when they were unfortunately discontinued, owing apparently to the following observation in a Report to the Treasury by Messrs Bonamy Price and Frederick St. John, who conducted an official inquiry into the duties of the Fishery Board in the previous year. They expressed the opinion that the statistics of the Board 'might be made less elaborate without detriment, and the 'officers thereby relieved from some arduous and unnecessary toil.' On inquiry, I learned that these statistics, although not published, had happily been continued with the greatest regularity by the Fishery officers, and the books in which they were contained were placed at my disposal for this investigation. These books also contained other relative information, such as the numbers of fishing boats from year to year belonging to the different classes—information first published in 1855, and withdrawn after 1857. The labour involved in transcribing the statistics from the various districts for the past thirty-six years, and in tabulating and analysing them, has been serious; but I think the results justify the trouble taken, since they furnish an amount of statistical information in regard to the development of the Scottish sea fisheries, which cannot be

paralleled in the history of the fisheries in any other country. The statistics may be grouped as follows:—

A. *MEN AND MATÉRIEL.*

1. 1809–1891. — Herring busses, tonnage, crew, salt, netting, &c.
2. 1821–1890.—Vessels fitted out for cod and ling fishery, tonnage, men.
3. 1825–1891.—Number of fishermen and others employed; number of boats.
4. 1844–1891.—Tonnage of boats, area of netting, length of lines; value of boats and gear.
5. 1855–1891.—Number of 1st, 2nd, and 3rd class boats.
6. 1874–1891.—Tonnage of 1st, 2nd, and 3rd class boats.
7. 1883–1891.—Number, tonnage, and value of beam-trawl vessels.

B. *PRODUCT.*

1. 1809–1891.—Barrels of herrings cured, branded, and exported.
2. 1821–1891.—Cod and ling cured and exported.
3. 1843–1857.—Herrings, and cod and ling consumed fresh.
4. 1883–1891.—Fish and shell-fish consumed fresh, and value thereof.

*Men and Matériel.*

In discussing the statistics, I have, for reasons needless to explain here, discarded altogether those relating to the herring busses and the vessels fitted out for the cod and ling fishery. The remaining statistics have been grouped together into periods of five years, and the mean of each period taken.

In Table I. are given the means for the last sixty-six years of the numbers of fishermen and boys and of fishing boats engaged in the Scottish sea fisheries, and the values of the boats and gear. The figures relate only to fishing boats, those referring to beam-trawl vessels having been deducted. It will be observed in this economic picture that there has been a steady and almost continuous increase since 1825, in each successive quinquennial period, of men, boats, and values until the period terminating with 1889, after which a decrease is shown. Examination of the figures for each year during the last decade proves, however, that this decline began in 1886, and has continued without interruption from year to year since. If the three periods, 1882–86, 1887–91, and 1890–91, indicated in the Table be compared, this fact is plain.

But while up to 1886 an almost continuous increase of men and progressive development of *materiel* are shown, comparison of the different columns in the Table brings out some interesting results. Thus, the number of fishermen and boys engaged in the sea fisheries has not increased as one might have anticipated, and not certainly in proportion to the ordinary increase in the general population. The mean annual number from 1825 to 1829 was 37,457, in 1890–91 it was 46,337 (in 1891, 45,524), and the highest annual mean was in the period 1885–89—namely, 49,160. Contrasting the numbers for the last five years (1887-91) with those for the first five years (1825-29), we find the increase has been just about 10,000, or about 27 per cent. The increase in the *number* of boats from 8,921 in the first period to 14,494 in the last has been relatively greater (62 per cent.), but the tonnage has increased in far greater proportion. We have no information as to the tonnage of the boats until

TABLE I.—Showing the Annual Mean Numbers, for Successive Quinquennial Periods, of Fishermen and Boys, Boats and Tonnage thereof, and the Values of Boats and Gear (exclusive of Beam-Trawlers) since 1825.

| Period. | Number of Fishermen and Boys. | Boats. | | | Value of | | Total Value of Boats and Gear. | Total Number of Persons Employed. |
|---|---|---|---|---|---|---|---|---|
| | | Number. | Tonnage. | Value. | Nets. | Lines. | | |
| | | | | £ | £ | £ | £ | |
| 1825–29 | 37,457 | 8,921 | ... | ... | ... | ... | ... | ... |
| 1830–34 | 38,645 | 9,149 | ... | ... | ... | ... | ... | ... |
| 1835–39 | 38,942 | 9,299 | ... | ... | ... | ... | ... | ... |
| 1840–44 | 40,267 | 9,892 | ... | ... | ... | ... | ... | ... |
| 1845–49 | 40,087 | 10,398 | 68,493 | 209,805 | 280,701 | 41,220 | 531,726 | ... |
| 1850–54 | 38,275 | 10,353 | 68,864 | 195,996 | 258,129 | 47,988 | 501,933 | ... |
| 1855–59 | 40,297 | 11,772 | 81,459 | 237,417 | 345,237 | 60,386 | 643,040 | 90,182 |
| 1860–64 | 40,600 | 12,467 | 89,831 | 276,248 | 405,811 | 68,020 | 750,079 | 88,231 |
| 1865–69 | 43,353 | 13,523 | 103,125 | 338,158 | 519,914 | 82,267 | 940,340 | 87,261 |
| 1870–74 | 45,851 | 15,084 | 105,687 | 382,881 | 524,793 | 98,105 | 1,005,778 | 89,410 |
| 1875–79 | 45,853 | 14,543 | 106,885 | 482,153 | 578,827 | 109,417 | 1,170,399 | 90,572 |
| 1880–84 | 48,628 | 15,033 | 118,002 | 666,218 | 705,320 | 115,281 | 1,486,778 | 98,988 |
| 1885–89 | 49,160 | 15,019 | 125,064 | 777,869 | 713,708 | 124,131 | 1,615,708 | 99,173 |
| 1890 and 91 | 46,337 | 14,017 | 114,726 | 680,571 | 616,519 | 127,429 | 1,424,518 | 96,784 |
| 1882–86 | 49,579 | 15,253 | 124,816 | 756,394 | 754,832 | 118,708 | 1,629,934 | 100,180 |
| 1887–91 | 47,691 | 14,494 | 119,194 | 724,041 | 654,287 | 126,678 | 1,505,005 | 98,300 |

1844, but the gross tonnage increased in the period between 1845-49 and 1885-89 by no less than 56,591 tons. The Scotch fishing boat of forty-five years ago had an average tonnage of about 6·5; in the period from 1885-89 the average tonnage was 8·3, and it was 8·1 in 1890-91. These figures refer to the boats of all classes—the relative increase in the tonnage of first-class boats has been immensely greater. The value of the boats has also greatly increased. In 1845-49 the value of the fishing boats was £209,805, or an average per boat of about £20, 3s. In 1885-89 the value was £777,869—or greater by £568,064 than in the earlier period—and the average value per boat was about £51, 15s. So with the fishing gear. In the first period of the series the mean annual value was £321,921; in the period from 1885 to 1889 the mean annual value was £837,839—an increase of nearly £516,000. The value of lines has increased in greater ratio than the value of herring nets, and it will be seen from the table that, while in late years there has been a considerable diminution in the number of fishermen and boats, in the tonnage and value of boats, and in the value of nets, the value of lines has gone on progressively increasing.

The figures which I have given show how very great have been the progress and development of the Scotch sea-fisheries during the last sixty-five years. The number of men and boats, and the seaworthiness of the latter, have greatly increased; and there has been a corresponding prosperity among the fishing population. This progress may be shown very effectively if the number of fishermen is used as a basis upon which to group the figures relating to boats and gear. In Table II. I give the ratios corresponding to each hundred fishermen in the various periods since 1825.

TABLE II.—Showing the Annual Mean Number of Boats, the Tonnage and Value thereof, and the Value of Boats and Gear *per Hundred Fishermen* since 1825.

| Period. | Boats. | | | Value of | | Total Value of Boats and Gear. |
|---|---|---|---|---|---|---|
| | Number. | Tonnage. | Value. | Nets. | Lines. | |
| | | | £ | £ | £ | £ |
| 1825–29 | 23·8 | ... | ... | ... | ... | ... |
| 1830–34 | 23·7 | ... | ... | ... | ... | ... |
| 1835–39 | 23·9 | ... | ... | ... | ... | ... |
| 1840–44 | 24·5 | ... | ... | ... | ... | ... |
| 1845–49 | 25·9 | 170·8 | 523·3 | 700·2 | 102·8 | 1,326·4 |
| 1850–54 | 27·0 | 179·9 | 512·0 | 674·4 | 125·3 | 1,311·8 |
| 1855–59 | 29·2 | 202·1 | 589·1 | 856·7 | 149·8 | 1,595·7 |
| 1860–64 | 30·7 | 221·2 | 680·4 | 999·5 | 167·5 | 1,847·5 |
| 1865–69 | 31·2 | 237·8 | 780·0 | 1,199·2 | 189·7 | 2,169·0 |
| 1870–74 | 32·9 | 230·5 | 835·0 | 1,144·5 | 213·9 | 2,193·6 |
| 1875–79 | 31·7 | 233·1 | 1,051·5 | 1,262·4 | 238·6 | 2,552·5 |
| 1880–84 | 30·9 | 242·6 | 1,370·0 | 1,450·5 | 237·1 | 3,057·6 |
| 1885–89 | 30·5 | 254·4 | 1,582·3 | 1,451·8 | 252·5 | 3,286·7 |
| 1890 and 1891 | 30·2 | 247·6 | 1,468·7 | 1,330·5 | 275·0 | 3,074·3 |
| 1882–86 | 30·7 | 251·7 | 1,525·6 | 1,522·4 | 239·4 | 3,287·4 |
| 1887–91 | 30·3 | 249·9 | 1,518·2 | 1,371·9 | 265·6 | 3,155·8 |

This table shows at a glance the gradually increasing capital embarked by the fishing population in their boats and gear. Forty-five years ago, each hundred fishermen possessed very nearly 26 boats of an aggregate tonnage of 170·8, and of the value of £523, 6s.; the value of their nets was £700, 4s., and of their lines £102, 16s., the gross value of their boats and gear being £1,326, 8s., or £13, 5s. 3d. per head. In the period 1885–89, each hundred fishermen owned 30·5 boats, of an aggregate tonnage of 254·4, and valued at £1,582, 6s. The value of their nets was £1,451, 16s., and of their lines £252, 10s., the total value of the boats and gear being £3,286, 14s., representing a sum of £32, 17s. 4d. per head.

As in the previous table, the figures for recent years show a gradual decline in the number, tonnage, and value of boats, and in the value of nets per hundred men employed, and a gradual rise in the value of lines. In 1885 the average amount of capital invested by each fisherman in his boat and fishing gear was £33, 10s. 8d.; from that time it has gradually fallen, and was £31, 1s. 10d. in 1891.

Passing to the consideration of the statistics relating to the extent of the machinery or apparatus of capture, we find that a correspondingly great increase has taken place. At the present day the fishermen possess not only more and better boats than they did previously, but they are provided with a much larger quantity of netting and longer lines. In Table III. are given the mean annual number of herring boats, the extent of netting in square yards, and of lines in fathoms, in each of the five-yearly periods since 1844. It shows at a glance the enormous increase which has occurred during the last fifty years in the apparatus for capturing fish.

TABLE III.—Showing the Annual Mean Number of Boats employed in the Herring Fishery, together with the Extent of Netting and the Length of Lines belonging to the Fishermen since 1844.

| Period. | Number of Herring Boats. | Area of Netting in Square Yards. | Length of Lines in Fathoms. |
|---|---|---|---|
| 1844 | ... | 51,995,003 | 8,501,775 |
| 1845–49 | ... | 72,796,071 | 13,576,449 |
| 1850–54 | ... | 76,062,366 | 13,610,144 |
| 1855–59 | 6,617 | 83,030,518 | 17,198,492 |
| 1860–64 | 7,535 | 101,038,950 | 19,363,729 |
| 1865–69 | 8,092 | 134,269,391 | 23,601,765 |
| 1870–74 | 8,371 | 145,059,263 | 28,256,896 |
| 1875–79 | 7,893 | 159,270,214 | 30,327,611 |
| 1880–84 | 8,205 | 187,848,524 | 32,213,251 |
| 1885–89 | 7,702 | 192,547,414 | 35,578,436 |
| 1890–91 | 6,704 | 169,917,885 | 35,618,978 |

Thus, in 1844 the total area of the herring nets in Scotland was 51,995,000 square yards, while in the period 1885–89 the area was 192,547,000 square yards—very nearly a fourfold increase. The length of lines has advanced in even greater proportions—from 8,501,775 fathoms in 1844 to 35,578,436 fathoms in 1885–89—an increase of 27,076,661 fathoms or more than four-fold.*

* The great extent of the nets and lines possessed by the Scottish fishermen may be made more obvious by a few comparisons. Thus, last year (1891), the length of

This enormous development in gear, like that in the boats, has been specially marked on the East Coast. The West Coast Fisheries have remained, relatively speaking, stationary—progress at one place being counterbalanced by decadence somewhere else. It has been already seen that in 1809, when fishery officers were first appointed, seven of them were placed on the West Coast and only three on the East Coast, two of them being stationed on the Firth of Forth (Leith and Burntisland), and the third at Wick, and this may be taken as typical of the condition of the fisheries on the two coasts at that time. I know nothing in the history of European fisheries more remarkable than the creation during this century of the great fishery on the East Coast of Scotland, along an iron-bound, inhospitable, and comparatively harbourless coast, except the creation of an even greater fishery, many centuries earlier, among the dreary sand-dunes of Holland; and it speaks volumes for the laborious toil, enterprise, and energy of the indomitable race which inhabits it. The conditions which assisted in the development of the East Coast Fisheries are more complex than might at first sight appear.

In regard to the statistics referred to, the following examples may be given:—In 1858–59 there were 2,634 herring boats belonging to the West Coast, 19,810,000 square yards of netting, and 2,987,500 fathoms of lines. On the East Coast, at the same period, there were 4,232 herring boats, 65,493,000 square yards of nets, and 15,074,000 fathoms of lines. In 1885–89 the number of herring boats on the West Coast averaged 3,338, the netting 29,794,000 square yards, and the lines 4,505,000 fathoms. On the East Coast, the average for the same period was 4,364 herring boats, 162,752,000 square yards of netting, and 31,073,000 fathoms of lines.

TABLE IV.—Showing the Annual Mean Number of Herring Boats (with the Netting belonging to each), the Extent of Netting, and Length of Lines, possessed by *each Hundred Fishermen* in Quinquennial Periods since 1844.

| Period. | Number of Herring Boats. | Area of Netting in Square Yards. | Length of Lines in Fathoms. | Average Area of Netting per Herring Boat. |
|---|---|---|---|---|
| 1844 | ... | 130,598 | 14,235 | ... |
| 1845–49 | ... | 181,595 | 22,578 | ... |
| 1850–54 | ... | 196,113 | 23,706 | ... |
| 1855–59 | 16·4 | 206,046 | 42,679 | 12,548 |
| 1860–64 | 18·5 | 248,864 | 47,694 | 13,409 |
| 1865–69 | 18·6 | 309,712 | 54,441 | 16,593 |
| 1870–74 | 18·2 | 316,371 | 61,627 | 17,328 |
| 1875–79 | 17·2 | 347,349 | 66,141 | 20,181 |
| 1880–84 | 16·9 | 386,312 | 66,246 | 22,894 |
| 1885–89 | 15·6 | 391,674 | 72,373 | 24,999 |
| 1890–91 | 14·4 | 366,700 | 76,869 | 25,345 |

the lines exceeded 41,121 miles—long enough to engirdle the earth once and nearly three-quarters. The mean area of the netting in the period 1885–89 amounted to 39,783 acres, or over 62 square miles; suspended in the water, as in fishing, they would extend to a distance of over 7000 miles [7293], sufficient to stretch across the Atlantic twice, and about twenty times across the North Sea.

The gradual but enormous increase in the apparatus of capture may, as with the boats and capital, be conveniently exhibited in relation to the number of fishermen. In Table IV. I have given these particulars.

From this table we may see how the apparatus of capture per head of the fishing population has increased. In 1844 each hundred fishermen possessed 130,598 square yards of netting, and 14,235 fathoms of line. In the period 1885–89 the same number of fishermen possessed 391,674 square yards of netting, and 72,373 fathoms of line. Thus, about half a century ago, each Scotch fisherman was equipped for his duties on the sea with 1,306 square yards of net and 142 fathoms of line, while in 1885–89 he was equipped with 3,917 square yards of netting and 724 fathoms of lines. Last year, the number of fathoms of lines belonging to each fisherman and boy was nearly 769.

The first column, showing the number of herring boats belonging to each 100 fishermen, is instructive. It will be seen that, from the period 1865–69, the ratio of the number of herring boats to fishermen has progressively decreased. This, however, is accounted for by the circumstance that the boats began then to fish in greater and greater numbers at distances from shore, and increased greatly in size, tonnage, and value. The increase in the quantity of netting per boat is shown in the last column. In 1855–59 each herring boat, on the average, possessed 12,548 square yards of netting, while in 1890–91 each such boat possessed more than double this quantity, viz., 25,345 square yards, and the increase between the periods referred to was continuous and progressive. The length of lines per boat cannot be ascertained with anything like accuracy. The average per herring boat refers to the whole of Scotland; but here, also, it could be shown that the increase on the East Coast has been very much greater than on the West. From information obtained from the Fishery Officers, it may be said that a first-class herring boat on the East Coast ranges up to 38 or 39 tons, and carries during the summer fishing from about 35,000 to over 60,000 square yards of netting. In the Anstruther district the maximum length of great fishing lines per boat is, at the present day, 15,750 fathoms, and the average 12,600 fathoms; while, thirty years ago, the length was only 5400 fathoms.

### *Beam-Trawl Vessels.*

Beam-trawling has been practised for a considerable number of years at certain parts of the Scottish coast, and particularly in the Firths—the Firth of Forth, the Moray Firth, the Clyde, and the Solway. But up to about ten or twelve years ago it was prosecuted only intermittently by fishing boats engaged at other times in other work. At the period mentioned the introduction of steam-trawl vessels may be said to have revolutionised this mode of fishing. Statistics are only available since the year 1883, and they are as follows:—

TABLE V.—Statistics relating to Beam-Trawl Vessels.

| Year. | Steam Trawl Vessels. | | | | | Total Trawl Vessels (including Sailing Vessels and Boats). | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | Tons | Men. | Value of Vessels. | Value of Nets, &c. | No. | Tons | Men. | Value of Vessels | Value of Nets, &c. |
| | | | | £ | £ | | | | £ | £ |
| 1883 | ... | ... | ... | ... | ... | *47 | 2004 | ... | 59,980 | ... |
| 1884 | ... | ... | ... | ... | ... | 61 | 2284 | ... | 117,770 | ... |
| 1885 | ... | ... | ... | ... | ... | 105 | 2857 | ... | 114,845 | ... |
| 1886 | ... | ... | ... | ... | ... | 109 | 2914 | ... | 94,849 | ... |
| 1887 | ... | ... | ... | ... | ... | 103 | 2304 | ... | 73,394 | ... |
| 1888 | ... | ... | .. | ... | ... | 107 | 2689 | ... | 84,421 | ... |
| 1889 | 38 | 4369 | 276 | 109,906 | 4810 | 110 | 4982 | 478 | 111,174 | 6204 |
| 1890 | 47 | 4105 | 350 | 144,805 | 6920 | 118 | 4705 | 495 | 148,873 | 8258 |
| 1891 | 61 | 5929 | 457 | 208,452 | 8410 | 132 | 6484 | 626 | 212,113 | 9662 |

* Nearly all steamers.

These statistics would have been more useful if details had been given for the years 1883–88 as they have been since the latter year; but they show the great increase which has occurred in trawling vessels. In 1883 there were 47, of a gross tonnage of 2,004, and valued at £59,980. Last year the number was 132, of 6,484 tons, and valued at £212,113, the value of their gear being £9,662 in addition. Of these trawlers 71 were sailing vessels or boats of an aggregate value of £3,661; the value of the 61 steam vessels being £208,452.

Thus, while there has been a falling off in the number of fishermen and fishing boats since 1886, there has been an almost progressive increase in the number, tonnage, and value of beam-trawlers. The importance of this fact will be seen when we come to deal with the statistics of the fish captured.

The facts and figures set forth in the foregoing pages show that a very great increase has taken place in the men, boats, and gear employed in the fisheries, and in the capital embarked—especially on the East Coast—since 1825. They also show an immense increase in the apparatus or machinery for the capture of fish, both in the aggregate and when considered in relation to the number of men and boats employed. Thus, we have been able to ascertain with considerable accuracy the data concerning this side of the inquiry. I turn now to the statistics relating to the *produce*—the fish caught.

### 3. Statistics of Fish Caught.

The statistics of the fish captured are much less satisfactory than those of the men, boats, and gear. The reason of this is to be found in the fact, previously adverted to, that the fishery statistics originated in the bounty system, and hence, for a long time, only certain fish cured in a certain way came under review. For a comparatively brief period—from

1843 to 1857—an attempt was made to keep a record of herrings and cod and ling sold or consumed fresh—but a complete return of the quantities and values of the whole produce of the sea-fisheries was not begun until 1883. If the quantities of cured fish bore always, throughout a long period, a fairly constant relation to the quantity caught, it might be possible to indicate with considerable accuracy the total yield annually. But it cannot be said that this is the case; hence results obtained in this way would be misleading. There is no doubt that in the earlier part of the period under consideration the quantity of fish cured bore a considerably larger proportion to the total fish landed than is the case now. The extension of railways, the aggregation of population in centres with a well organised system of distribution, the increase of wealth, &c., have put a premium upon fresh fish. It might be worth while to make a comparison here between the average catch of herrings and the netting in the periods for which returns are given—but the alteration which took place by the substitution of cotton nets with smaller meshes, and the prevalence of 'surface fishing' since 1857, would affect the result very considerably:—taking only the number of barrels of herrings *cured* the results are as follows in relation to the quantity of netting used.

TABLE VI.—Showing the Mean Annual Number of Barrels of Herrings Cured and the Area of Netting per Barrel since 1844.

| Period. | Number of Barrels Cured. | Number of Square Yards of Netting per Barrel Cured. | Period. | Number of Barrels Cured. | Number of Square Yards of Netting per Barrel Cured. |
|---|---|---|---|---|---|
| 1844 | 526,032 | 98·8 | | | |
| 1845–49 | 623,581 | 116·6 | 1870–74 | 874,458 | 165·9 |
| 1850–54 | 610,286 | 124·6 | 1875–79 | 823,292 | 193·4 |
| 1855–59 | 597,021 | 139·1 | 1880–84 | 1,366,844 | 137·4 |
| 1860–64 | 695,878 | 145·2 | 1885–89 | 1,340,996 | 143·5 |
| 1865–69 | 686,415 | 195·6 | 1890–91 | 1,215,337 | 139·8 |

For the reasons given, and for others not needful to detail, too much weight should not be given to these figures. It would be necessary to institute a comparison on subsidiary points, and I have found this at present too laborious. It may be pointed out, however, that during the first half of the period under review, when hemp nets of large mesh were employed, there was a gradual increase from period to period in the area of netting per barrel. In subsequent years, when the area of fishing was extended, immature fish or 'matties' began to be caught in large numbers by the cotton nets. In 1859 only 40 barrels of 'matties' were cured; in 1865 the number of 'matties' branded was 770; in 1869 1,964, and in 1870 36,839, from which time the number increased greatly, but not steadily, reaching 200,000 barrels in 1880.

Of more importance is the study of the statistics relating to white fish, which are caught by lines and beam-trawls. Here also, however, they are

not as satisfactory as is desirable, since beam-trawled fish were first differentiated in the official returns only as late as 1889, and the quantities of fish used fresh have only been given since 1883. Nevertheless, it is possible to institute some useful comparisons. Thus, between 1854 and 1857, statistics were published representing the total quantities of cod, ling, &c. cured and used fresh, and likewise the length of lines possessed by the fishermen. These statistics give the following results:—

| Period. | Length of Lines in Fathoms. | Quantity of Cod, Ling, &c., caught in cwts. | Fathoms of Lines per cwt. of Fish caught. |
|---|---|---|---|
| 1844 | 8,501,775 | 297,230 | 28·5 |
| 1845–49 | 13,576,449 | 331,058 | 41·0 |
| 1850–54 | 13,610,144 | 330,472 | 41·2 |
| 1855–57 | 16,622,630 | 372,776 | 44·5 |

These statistics extend over thirteen years, and they were apparently collected on a uniform basis throughout the period. The gradual increase in the length of the lines in relation to the fish caught may, therefore, indicate approximately what the case really was.

Unfortunately, a similar return cannot be made for the years since 1883, for the reason stated in regard to trawled fish, and also because it is uncertain whether the above figures refer exclusively to cod and ling—or partly to other white fish as well. The only period during which a comparison can be made with anything like accuracy is from 1889 to 1891, when trawled fish were separately recorded, and hence the line-caught fish may also be ascertained. The figures are as follows:—

| Period | Length of Lines in Fathoms. | Quantity of Fish caught in cwts. | Fathoms of Lines per cwt. of Fish caught. |
|---|---|---|---|
| 1889 | 36,793,834 | 1,612,418 | 22·8 |
| 1890 | 35,672,745 | 1,577,298 | 22·3 |
| 1891 | 36,187,132 | 1,564,189 | 23·1 |

But it is evident the period is far too short for any conclusion to be based upon these figures alone, and in the latter table all kinds of white fish are included.

But the strongest evidence of over-fishing is to be obtained from the statistics relating to beam-trawling. These have been given (p. 182), so far as concerns the number of vessels, tonnage, and value. In regard to the quantity of fish caught, the figures are instructive. In the following table I give the tonnage of the vessels and the weight of fish caught in the years 1889–1891, as extracted from the official records; the weight of fish caught in 1888 is known for the East Coast and calculated for the West Coast.

| Year. | Tonnage. | Fish caught in cwts. | Cwts. per ton of Vessel. |
|---|---|---|---|
| 1888 | 2,689 | 250,000 | 92·9 |
| 1889 | 3,608 | 252,524 | 69·9 |
| 1890 | 4,705 | 291,812 | 62·0 |
| 1891 | 6,484 | 323,046 | 49·8 |

These figures show very clearly that the quantity of fish taken *per ton* of the vessels tonnage has greatly diminished in recent years. The figures relating to the quantity of fish caught refer to all kinds of fish; but I have also made a comparison of the quantities of round-fish and flat-fish for the same periods. The total quantities of these fish caught are as follows:—

| Year. | Round-Fish. | Number of cwts. per Ton of Vessels Tonnage. | Flat-Fish. | Number of cwts. per Ton of Vessels Tonnage. |
|---|---|---|---|---|
| 1888 | 183,000 | 68·0 | 67,000 | 24·9 |
| 1889 | 183,787 | 50·9 | 68,737 | 19·3 |
| 1890 | 213,078 | 45·2 | 78,734 | 16·7 |
| 1891 | 242,501 | 37·4 | 80,546 | 12·4 |

These figures show that since statistics have been collected—or published—there has been a gradual and considerable diminution of the average catch of Scotch beam-trawlers *per ton* of the vessels tonnage. The figures given for flat-fish in the above table include, also, skates; in the following table I give the averages *per ton* for the different kinds of flat-fish for the last three years.

| Year. | Turbot. | Halibut. | Lemon Soles. | Flounders, Plaice, and Brill. | Skates. |
|---|---|---|---|---|---|
| 1889 | 1·40 | 0·02 | 3·89 | 12·84 | 0·81 |
| 1890 | 0·85 | 0·009 | 3·47 | 11·52 | 0·86 |
| 1891 | 0·63 | 0·005 | 2·68 | 7·88 | 1·21 |

I think it will be admitted that these figures convey an important lesson in connection with this question of over-trawling. The falling-off has occurred, it will be observed, mainly in the larger and more valuable flat-fish, but it has been common to all kinds. Very few halibut are ever caught in the trawl-net—only about 0·17 per cent. of the total catch; but the beam-trawl is the great instrument by which the supplies of

turbot and other flat-fish are obtained. Thus, last year this mode of fishing yielded the following proportion of the total catch :—turbot, 81·2 per cent. ; lemon soles, 98·2 per cent. ; flounder, plaice, and brill, 64·7 per cent. The total number of cwts. of these flat-fish landed in Scotland annually, since statistics began to be collected, are as follows—irrespective of the mode of capture :—

| Year. | Turbot. | Lemon Sole. | Flounder, Plaice, and Brill. | Year. | Turbot. | Lemon Sole. | Flounder, Plaice, and Brill. |
|---|---|---|---|---|---|---|---|
| 1883 | 3,902 | 1,702 | 67,226 | 1888 | 5,424 | 12,669 | 87,184 |
| 1884 | 4,234 | 4,163 | 72,758 | 1889 | 6,338 | 14,391 | 74,270 |
| 1885 | 7,350 | 5,898 | 83,180 | 1890 | 5,554 | 16,651 | 81,309 |
| 1886 | 3,882 | 7,573 | 81,164 | 1891 | 5,015 | 17,739 | 78,776 |
| 1887 | 5,282 | 11,737 | 96,354 | | | | |

Looking to the great increase in beam-trawling and line fishing, these figures are important. Despite the great increase of the machinery of capture, the gross quantity of flat-fish caught is diminishing. This is also the case off the East Coast of England, where beam-trawling is chiefly prosecuted, as the following figures, showing the quantities of flat-fish landed in the East Coast in recent years, indicate :—

| Year. | Turbot. | Soles. | Prime Fish, not separately distinguished. | Totals. |
|---|---|---|---|---|
| | Cwts. | Cwts. | Cwts. | Cwts. |
| 1887 | 57,561 | 67,874 | 109,424 | 234,859 |
| 1888 | 48,760 | 52,151 | 105,057 | 205,968 |
| 1889 | 44,272 | 47,747 | 25,848 | 117,867 |
| 1890 | 40,763 | 46,187 | 46,137 | 133,087 |
| 1891 | 47,594 | 61,287 | 43,728 | 152,609 |

For the years 1887-88 the mean annual yield was 220,413 cwts. ; for 1890-91 it was 142,848. It must be said, however, that since these statistics were begun only in 1887, and embrace a very large extent of coast, there may at first have been errors of classification and so forth. The increase noticeable last year may be due to the transformation taking place by the substitution of steam vessels for sailing vessels.

I have now discussed the statistics relating to the three great modes of sea-fishing in Scotland—nets, lines, and beam-trawls. I turn to certain special statistics dealing in detail with a portion of the East Coast, and which are of much value. In the first place, the trawling experiments of the 'Garland' have already yielded important results. These experiments have been carried on continually for six years in portions of the territorial waters in which beam-trawling has been during the whole

period prohibited; and I shall deal with those parts where the experiments have been carried on with the greatest regularity, namely, the Firth of Forth and St Andrews Bay. The figures show that considerable fluctuations have occurred in the abundance of fish caught; but, comparing the mean number of fish got in each haul of the net in the close area during the first three years and the last three years, we have the following result:—

| Years. | Flat-Fish. | Round-Fish. | Total. |
|---|---|---|---|
| 1886-1888 | 190·6 | 148·1 | 338·6 |
| 1889-1891 | 154·7 | 155·0 | 309·7 |

These figures are very instructive. They show that a decrease rather than an increase has taken place in the abundance of flat-fish in the territorial waters in which beam-trawling has been longest prohibited; and this, at first sight, seems paradoxical, since it is contrary to reason to suppose that the interdiction within a given area of an extensive mode of fishing, by which flat fish are chiefly captured, should lead to a diminution of the number of these fish within that area. But the researches made on board the 'Garland,' since the summer of 1888, furnish a probable clue. They have shown that most of the food-fishes—and nearly all the important ones—spawn outside the territorial waters in the region referred to—the pelagic eggs in the process of development being floated in immense numbers towards the shallower waters—and it may be said that scarcely any of the plaice, lemon soles, turbot, haddock, cod, &c., to be found within the Firth of Forth or St Andrews Bay were born there. They have been floated in at an early stage of their existence, or have migrated thither at a later period. Some 15,000 food-fishes have been carefully examined during the last four years, and not a single ripe cod, haddock, or plaice has been obtained within the territorial waters; a few mature lemon soles have been obtained at the margin. Further, tow-netting has been carefully carried on in connection with this inquiry, and the results show that, while the pelagic ova may be obtained in immense numbers outside the Firth of Forth and St Andrews Bay, they materially diminish in quantity further up the Firth. The hypothesis that seems to account for the diminution of flat-fish in the territorial waters is that the spawning fish are captured in greatly increased numbers on the spawning grounds lying outside, where the beam-trawlers—driven from the territorial waters—work on a larger scale than hitherto.

Statistics of the fish caught by line fishermen within the territorial waters along the greater part of the East Coast, during the past four years, also indicate depletion of inshore grounds. Thus, along this great extent of coast, the average quantity of white fish (including both round-fish and flat-fish) per 'shot' of the lines was as follows:—In 1888, 2·539 cwts.; in 1889, 2·494 cwts.; in 1890, 2·425 cwts.; in 1891, 2·438 cwts. These figures refer to nearly 100,000 cwts. of fish each year.

From the foregoing discussion of the statistics, I do not think it will be seriously contested that the supply of fish, relative to the machinery of capture, has diminished, and is likely to continue to diminish, especially as regards certain kinds. But this statistical discussion would be incomplete without reference being made to some other considerations.

In the first place, there is the question of the extent of the fishing grounds. In early times the fisheries on the East Coast were confined to the Firths and to a strip of water contiguous to the coast at certain places. And, until the period under consideration was well advanced, this continued to be the case. There was not a decked fishing boat from Berwick

to John o' Groat's—except a few 'busses' or vessels for deep-sea-fishing on the bounty system. The fishing boats were small and open, and the fishermen clung to the coasts and bays with the greatest pertinacity. Later, larger boats, partially or completely decked, began to appear, and the fishermen ventured further and further from shore, until for many years past they have ranged the northern parts of the North Sea—frequently fishing from 150 to 200 miles from shore, and even within view of the Norwegian Coast. This extension of the area of fishing is a most important consideration to be kept in view. Thus, Mr John Bain, the Fishery Officer for the Peterhead District, informs me that 'any increase 'that has taken place in the quantities of fish landed must be largely, if 'not wholly, attributed to the increased appliances in operation. A large 'depletion has taken place on the inshore fishing grounds, and the boats 'are now, to a large extent, fishing on what may be regarded as virgin 'soil. Some large quantities of halibut were got on these new grounds, 'but after a time a large decrease took place in the catch.' He states, further, that 'all our fisheries—lines and nets—have of late years been 'prosecuted with a diligence and to an extent quite unprecedented in past 'times. Larger boats, more and finer nets, more and better lines, and a 'larger area of fishing ground, seem to be requisite in order to keep up 'the supplies of fish.' Mr John Doull, the Fishery Officer of the Eyemouth District, also says: 'Fishermen, in general, assert that it now takes 'a much larger and finer quantity of herring nets, lines, and creels to 'capture the same quantity of herrings, white fish, crabs, and lobsters 'than it took twenty or thirty years ago. This shows that these descrip'tions of fish have, for a good many years past, been getting scarcer on the 'fishing grounds. From my long connection with the fisheries, I readily 'acquiesce in this opinion of the fishermen.' And these statements are confirmed at other parts of the coast.

Another consideration of importance is this, that by reason of the larger and better boats now employed, fishermen are able to prosecute their industry more continuously than before. They go to sea and shoot their nets and lines in weather which previously imprisoned them behind the harbour bar. For instance, at Macduff, Mr James Gow, the Officer of the Banff District, informs me that in February last, for two weeks, the boats were daily at sea, and landing large quantities of fish, the fishermen asserting 'that, with the same weather ten years ago, there would not 'have been a boat out in the district.' And further, for the same reason, line fishing is prosecuted for a considerably longer period than was formerly the case.

Were it possible to contrast the quantity of fish caught by the same extent of apparatus, say within twenty miles from the coast, at the present day, with the quantity taken twenty, thirty, or forty years ago, the difference, I think, would be immense.

### 4. How to Deal with Over-fishing.

Over-fishing may be dealt with in three ways:—(1) by restrictive regulation; (2) by endeavouring to increase the supply of fish by artificial propagation, leaving the practice of fishing free; (3) by a combination of restriction with artificial propagation.

Regulation may concern the place of fishing, the time of fishing, the mode of fishing, or the size or kind of fish caught, or, at least, landed, severally or in combination. There may be a total prohibition of a certain mode or modes of fishing, or of all fishing, in certain areas—either throughout the year or for a limited period ('close time'). Interference

may concern the apparatus by which the fish are caught—its nature, dimensions, the size of mesh, the size of hook (as in Spain), or the relation between the fishing apparatus used in a certain area. The latter mode of regulation merges into questions of police, and is very ancient and still practised. The earliest extant regulations of sea-fisheries are of this character; it was practised in the great herring fisheries of Scania, under the dominion of the Hanseatic League; and I find evidence of it in the sixteenth century in Scotland, in accordance with the 'ordinance maid in 'ancient tymes.' At the present day such regulations exist in Norway, Denmark, Holland, and elsewhere; and a system of licenses has been proposed in connection with the lobster fisheries of Canada.

Total prohibition of fishing within defined areas on depopulated grounds (*cantonnements de réserves*) has been advocated by an illustrious French authority, Professor A. F. Marion; and instances of the closure of certain areas against particular modes of fishing may be found in many countries. I am not aware of any special measures having been yet taken to protect spawning grounds by the institution of a close-time.

The attention of fishery authorities at the present day appears to be concentrated on the question of protecting immature fish, and at a recent conference in London of those representing the English fishery industry—and especially the trawlers of the North Sea—it was resolved to petition the Government to interfere with the sale of certain fish under certain sizes. For reasons previously stated at length,* it appears to me that the greatest difficulty may be found in practice in beneficially carrying out such regulations on the high seas. Merely to interdict the landing or sale of fish under prohibited sizes, leaving entirely free the conditions of capture, and the treatment of the prohibited fish immediately subsequent to capture, might simply cut off an appreciable source of food supply, and raise the price of the fish allowed to be sold, without materially increasing the resources of the sea. In its scientific aspects this question is now being investigated on the Continent in harmony with the following resolution, proposed by Dr P. P. C. Hoek, the Netherlands' delegate, at the London International Fisheries' Conference in 1890, and unanimously agreed to:—

'This Conference considers it desirable that, before the Official Con-'ference meets, the different nations interested in the sea fisheries 'of European waters will collect with, as little delay as possible, 'sufficient information, scientific as well as statistical, with 'regard to the damage done by the capture of undersized fish 'by their fishermen.'

To discuss here the bearings of the various modes of regulation adverted to would occupy a great deal of space; and the subject is not, perhaps, yet sufficiently investigated to make such discussion profitable. I therefore pass to consider the question of succouring the inshore fisheries by means of sea-fish culture.

## 5. The Artificial Propagation and Culture of Sea-Fish.

### *The Principles of Sea-Fish Culture.*

The part which has been taken by pisciculture during the present generation in replenishing the lake and river fisheries of several countries is well known.

On the Continent, and especially in America, such operations have been undertaken on a very liberal scale; and in this country pisciculture, in

* *Vide* my Paper on 'The Distribution of Immature Fish and their Capture by Various Modes of Fishing,' in the *Eighth Annual Report.*

relation to inland fisheries, has reached the perfection of art at the celebrated establishment at Howietoun. But pisciculture as applied to sea-fish is of quite recent date. Artificial fecundation and hatching of the eggs of certain sea-fishes has been accomplished on an experimental scale by many naturalists—by Sars in Norway, Professor M'Intosh and others in this country, by the German scientists on the Baltic, and in America. But the first to work at the subject successfully, from the practical point of view, appears to have been Captain G. M. Dannevig, the Director of the well-known sea-fish hatchery near Arendal, in Norway, and who is the greatest authority on the subject. His institution was established seven or eight years ago, and has since been enlarged. More recently, a hatchery for sea-fish was established in Newfoundland, and another in Canada; and at Wood's Holl and other stations in the United States the Fish Commission have engaged in sea-fish culture for a considerable number of years.

Before describing what is being done in Scotland, a word or two may be devoted to the enunciation of the principles upon which sea-fish culture rests. Owing to the intensity of the struggle for existence in the sea, the destruction which takes place at various stages in the life of fishes is immense. Hence, most sea-fishes produce an enormous number of eggs.* A single female turbot may produce in one season nine or ten millions; a cod, six or seven millions; a ling, twenty or thirty millions; a haddock, half a million to about a million, and so on. The import of this enormous fecundity has frequently been altogether misunderstood; arguments have been based upon it to show the inutility of interference in fisheries. In reality fecundity is a measure of the natural destruction that occurs in the life-history of any species, since, on the reasonable assumption that the total number of a species remains fairly constant over a period, it is only necessary that a few individuals of the new generation should, on the average, survive to the reproductive stage in order to keep up the relative abundance of that species. Hence the proportion of the eggs produced by sea-fishes which give rise to reproductive individuals is infinitesimal. Of the ten millions produced by the turbot, 9,999,998, or thereabout, take no part in the production of another generation, but are destroyed at one period or another when left to natural conditions. So with other species. Now, since the fundamental principle of pisciculture is the protection of the organism at its earlier stages from destruction by its natural foes, it would be desirable, from the most practical point of view, to know at what stage or stages this enormous destruction mostly occurs. Is it chiefly in the egg state, or in the larval, post-larval, or 'immature' periods? There are some facts of importance in considering this point. In the first place, as a general rule, the fecundity of species whose eggs are buoyant or pelagic, is considerably greater than the fecundity of species whose eggs are demersal or attached; in other words, the ratio of the destruction is much greater among the former. The number of ova produced no doubt depends to some extent on the size of the essential parts of the ovum and the rate of growth of the species; but, taking these factors as far as possible into account, it appears that the fact is as stated. The herring, for instance, produces about 30,000 eggs; the pogge (*Agonus*), about 1200; the lumpsucker, over 100,000. Some herring, possibly, reach sexual maturity within a year, but probably later in the great majority of cases; the lumpsucker probably takes at least as long as the cod. The destruction, therefore,

* *Vide* my paper on 'The Comparative Fecundity of Sea-Fishes,' *Ninth Annual Report.*

in the very early stages of the species producing pelagic ova—that is almost all the food-fishes—is comparatively immense. The Rev. Mr Green, Inspector of Irish Fisheries, found by experiment that minute Crustacea, which swarm in the surface waters, devour pelagic ova;* and Mr Scott has discovered that *Sagitta*, which exists in immense multitudes, preys upon larval fishes. That protection of the ovum alone is a most important factor is also indicated by the extremely low fecundity of the pipe-fish (*Syngnathus*).

But there is evidence from the life-history of *Zoarces* that the great destruction at all events occurs very early. Mr Jameson has made a series of careful observations at Dunbar, as to the number and sizes of the young of this viviparous fish, the size of the parent, and the rate of growth of the young. Of a large number of females, varying from about seven to 16 inches, the mean number of young was 65, the range being from twenty to over a hundred. Twenty-two specimens from a group of sixty-three, ranging in size from 38 mm. to 53 mm., and born on 8th January, were placed in a vessel of water, and have been reared since. On the 11th June their length ranged from 59 to 89 mm., the mean being 74 mm. Thus, in five months they had increased their length by from 21 to 36 mm. Comparison was made from time to time with young *Zoarces* caught in the sea, and it shows that those in captivity, which were supplied abundantly with food, were of a larger size. It is evident from these facts that *Zoarces* is far removed from sexual maturity during the first year, and probably does not reach it till the third year of its life, the period at which it is believed the cod first comes to maturity. Now the importance of these observations lies in this, that 40 or 50 of the progeny of a sea-fish, which becomes mature probably only in the third year of its life, are sufficient for the maintenance of the species; and assuming that, for example, the cod reaches maturity about the same epoch, and that there is no exceptional destruction after its young have reached a similar stage, the inference is permissible that of the 5,000,000 or 6,000,000 ova produced by a female cod, less than 100 survive to attain a length of two inches or so. In the light of the important observations of Dannevig on the rate of growth, it may be said that by placing some fifty of these young cod, between two and three months old, on the fishing ground, one adult cod will be available as a source of food supply.

Pisciculture, or the protection of the young, may cease when different stages have been reached: (1) it may be extended only to the ovum; (2) to the larval fish until the yolk is nearly absorbed; (3) the young fish may be reared to a certain size. The practice in sea-fish culture hitherto has been mainly to limit protection to the ovum, *i.e.*, to the period anterior to hatching—the newly hatched fry being then placed on the fishing ground. The protection during the first few w[illegible] when the ratio of destruction under natural conditions is exceedingly great, must be beneficial in equal ratio—but the amount of this benefit cannot be at present expressed numerically with any approach to exactitude. There is little doubt that the extension of protection until the yolk is about absorbed, when the young fish has to depend on external sources for its nourishment, would be of the greatest value. But for this purpose it is essential that large enclosures of sea-water should be available. After the absorption of the yolk there is a difficulty in providing suitable food for the young fish, and in sufficient abundance. This can be done also by means of

* It is possible that the comparatively small fecundity of the halibut and long rough dab is accounted for by the unusually large size of the ova which will prevent their being swallowed by hosts of minute crustacea, &c.

ponds communicating with the sea, and supplied in addition with a succession of certain invertebrates, which may be retained in separate compartments, and whose spawn or larvæ form a natural food to the fishes in their early stages.

In regard to the kinds of sea-fish for pisciculture, it may be said that hitherto operations on any large scale have been almost confined to the cod. Dannevig, however, has experimented also with the flounder, the herring, and with other species. It appears to me that in this matter we should be guided by the results of statistical inquiry as to what fisheries are on the down-grade, and what the most valuable fisheries are that may be succoured. From the preceding pages I think it is clear that in this country, and especially on the East Coast, the fisheries which at present stand most in need of replenishment by sea-fish culture are those for the valuable flat-fishes—turbot, halibut, brill, sole, lemon sole, and plaice; and a reference to my paper relating to the spawning of these fishes (p. 233) will show that several of them could be treated in succession in the same establishment.

### *The Board's Sea-Fish Hatchery at Dunbar.*

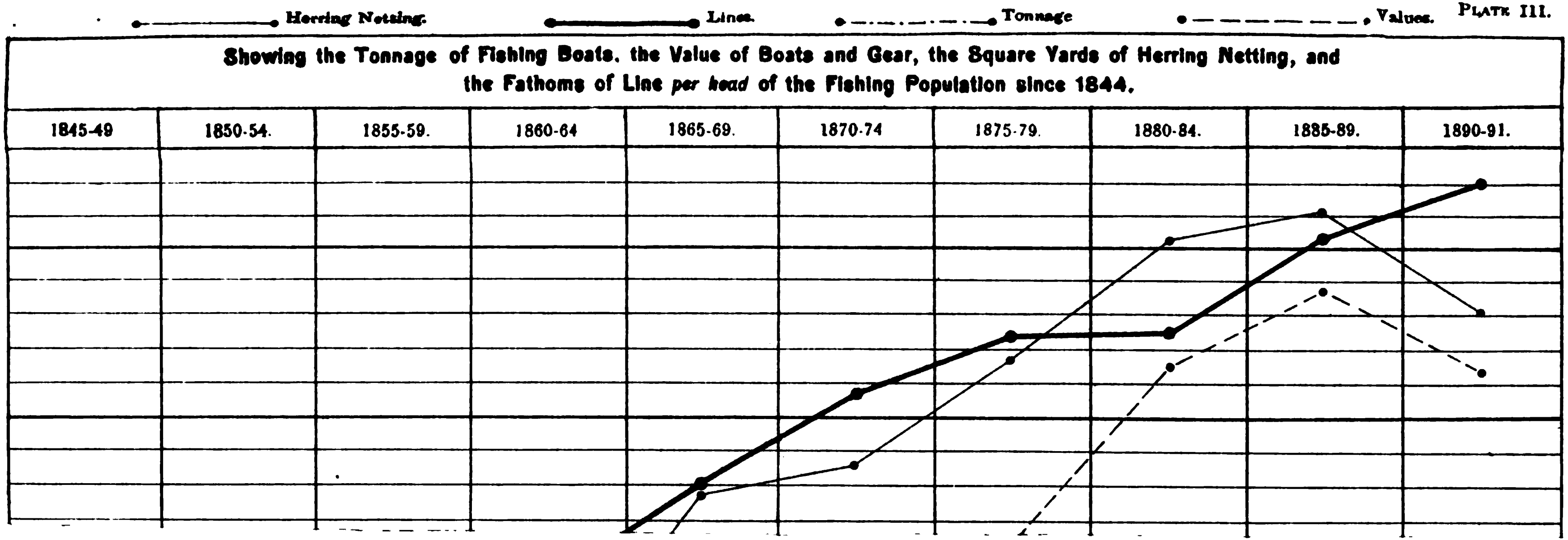
The Fishery Board had the subject of sea-fish culture under special consideration last year, and instructed me to visit and inspect Captain Dannevig's Sea-Fish Hatchery at Arendal, in order to see how a similar system might be adopted at Dunbar. Subsequently, on the invitation of the Board, Captain Dunnevig kindly came over to Scotland and examined the site of the proposed hatchery and sea-creeks adjacent, and having reported favourably, it was decided to erect a sea-fish hatchery at Dunbar on the model of the one in Norway. The essential requirements were (1) the erection of a hatching-house, with hatching apparatus; (2) the construction of a large spawning tank for the supply of the ova; (3) a suitable boiler, engines, pumps, and piping for supplying sea-water; and (4) the formation of a sea-water enclosure in which the adult fish could be collected and the fry reared. All these have now been provided, with the exception of the sea-water enclosure. The hatching-house and hatching boxes were made in Norway under the supervision of Captain Dannevig; the spawning tank has been constructed from plans prepared by Messrs Strain, Robertson, & Thomson, C.E., and the boiler and pumps were selected by Sir James Maitland and myself. The ground upon which the hatchery and its adjuncts have been erected belongs to the War Office and to the burgh of Dunbar, the use of which has been granted for the purpose.

The hatching-house (Pl. iv. A.) is a substantial double-walled wooden building, 35 feet long, 24 feet broad, and 18 feet high, standing on a foundation of brick and concrete, and it is so placed that it may be greatly extended in area later. The floor space at present permits of sixteen of Dannevig's hatching-boxes being employed, capable of containing at one time 80,000,000 fish ova, and this will allow of more than double that number to be manipulated during the spawning season of any one species, and many times that quantity if fish with different spawning times are employed.

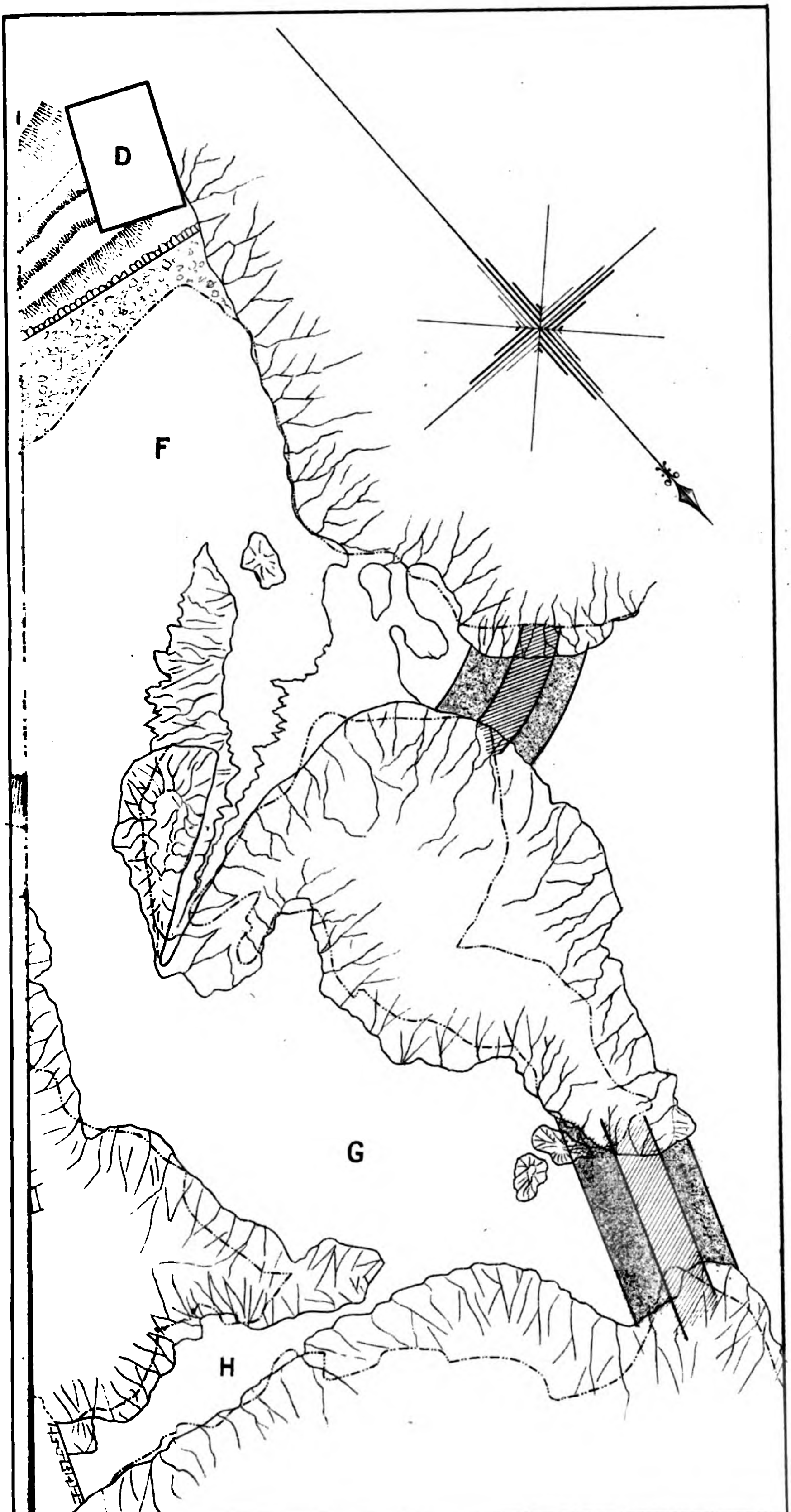
The spawning tank (fig. B.) is constructed of concrete sunk in the ground, the walls varying in thickness from 4 feet to 2 feet. It is 40 feet long by 11 feet 6 inches deep, the breadth at one end being 26 feet and at the other 18 feet; and it is capable of containing 60,750 gallons of

PLATE III.

Showing the Tonnage of Fishing Boats, the Value of Boats and Gear, the Square Yards of Herring Netting, and the Fathoms of Line *per head* of the Fishing Population since 1844.




V.


D
F
G
H

sea-water. It is situated 27 feet from the hatching-house and on higher ground, so that the level of the water in it will be above the level of the hatching-boxes in the present house. At the side next the hatching-house is the overflow shoot by which the floating ova are carried from the tank to the spawn-collector, within a compartment situated between the pond and the hatchery; and here also are placed in the bottom of the tank two 4-inch pipes, to be connected with the waste and drain pipes in order to empty the tank, or remove polluted water when required. There are also three 2-inch pipes placed at different levels; and, as the spawning pond will also be used as a reservoir for the supply of water to the tanks of the laboratory (fig. D), a pipe has been carried through into the laboratory (C), to be joined to the existing piping for that purpose.

To the front of the hatchery and spawning pond—between them and the harbour—is the boiler and pump-house (fig. E), with a concrete floor, and measuring 24 feet long by 18 feet in breadth. The boiler is of the locomotive type, made of steel, by Robey & Co., Lincoln, and of 8-horse power. The pumping apparatus consists of two Worthington, brass-lined, direct-acting steam pumps, each capable of throwing a minimum quantity of 2,040 gallons per hour, and a maximum of nearly double. The piping will be so arranged that water may be pumped directly from the harbour or from the creeks.

The fourth requisite for the hatchery—the enclosure of the sea-creeks—shown on the plan has not yet been carried out. These tidal creeks (F, G), according to the report of the engineers, will contain, when enclosed, a body of sea-water of a superficial area of 13,545 square feet, a maximum depth of 16 feet, and contents of 560,000 gallons. The whole of this will be required for the collection and storage of the adult fish to be used at the spawning time, and for rearing the fry. Pending this, it has been decided to convert the small sub-creek (H) into a tidal pond by the construction of a concrete wall in which a small number of fish may be preserved.* The gradual collection of the fish prior to the spawning period has been shown to be absolutely essential in order to obtain the necessary quantity of spawn at the proper time.

* It may be stated that the hatchery is within the precincts of one of the most historic spots in Scotland—the old Castle of Dunbar, associated with Scottish history for 800 years, and dismantled subsequent to the flight of Queen Mary and Bothwell, who took refuge in it (*I. James VI.*, c. 35, 1567). A portion of the sub-creek referred to, now being converted into a peaceful fish-pond, formed the dungeon in which the poet, Gavin Douglas, Bishop of Dunkeld, and many other illustrious prisoners were confined. A dark and tortuous passage still exists leading upwards towards the citadel. The westward opening is conjectured to have been the portal through which Sir Alexander Ramsay of Dalhousie brought succour to Black Agnes, during the siege of the Castle by the English under the Earls of Salisbury and Arundel, in 1338; and it was probably by this postern that King Edward II. escaped in a fishing boat, after his disastrous defeat at Bannockburn in 1314.

# IV.—THE CLYDE MUSSEL BEDS. (Pl. V.)

By J. H. Fullarton, M.A., D.Sc., F.R.S.E.

In previous Annual Reports of the Board, the two systems of mussel culture were described at length, the bed system* by Mr Scott and the writer, as undertaken at Montrose Basin, and the bouchôt system† by me, as practised in France, and illustrated by the Board's experimental bouchôt erected in the estuary of the Eden. At these two localities, Montrose and St Andrews, are the only beds where mussel culture in Scotland is assiduously engaged in, and at the former bed cultivation is successfully carried on in the face of great natural obstacles. Although the need of an increased supply of mussels for bait to the line fishermen is as keenly felt as ever, yet the cultivation, after approved methods, has not extended to places in Scotland beyond those mentioned. Notwithstanding, there is an abundance of ground where, by cultivation, the yield of mussels could be enormously increased, and the wants of the fishermen fully satisfied. Doubtless, the desire for and expectation of legislation on the mussel question may delay intending mussel cultivators from engaging in mussel culture. It is not creditable to us Scotsmen that line fishermen of the East Coast, and of the shores of the Moray Firth, should have to depend for a supply of bait on mussels imported from the Zuider Zee, in Holland, while there is so much uncultivated ground in our own country, where mussels could be reared and fattened. Such uncultivated and suitable ground is to be found in the three great estuaries of the Clyde, Forth, and Tay, and at the head of many of the Western and Northern lochs. The mussel beds of the Clyde have been selected as embracing one of our most extensive mussel areas, and I have been engaged in its examination, with a view of ascertaining their present condition, and their capabilities for yielding an increased supply of mussel bait for our line fishermen.

## Present Condition.

The estuary of the river Clyde, with its extensive mud banks and flats, is capable of producing vast quantities of mussels. The mussel area may be said to begin at Port-Glasgow and Cardross, and to stretch seawards to a line from Princes Pier on the south to Ardmore Head on the north. A great portion of this area is mussel producing; in fact, all of it, except the sand of the banks, and the shifting and silting mud of the navigable channel furnishes mussels.

The quantity of mussels obtained has varied much in different years. Within the last ten years as many as (in 1886) 3,850 tons, and 3,782 tons (in 1887), were lifted. These large quantities were not lifted from the uncultivated beds of the Clyde with impunity, for the beds were greatly impoverished, and, as a result, only 221 tons could be obtained in 1889. Had the beds been cultivated the deterioration would not have amounted to so much, and the beds would have been capable of yielding a much larger proportion than one-seventeenth of the yield of two years previously.

The diminished yield forced the mussel rakers of Port-Glasgow to go further afield, and such places as Loch Foyle, Belfast Loch, and Loch

* Mussel Farming at Montrose, *Seventh Annual Report*.

† On Bouchôt Mussel Culture and the Board's Experiment at St Andrews, *Ninth Annual Report*.

Etive were visited, and the mussels were lifted regardless of the future condition of the beds in these lochs. In this way, for the time being, the beds there were destroyed, and the over-fishing prevented the seeding and restocking of the beds for several years thereafter. Moreover, the increased demand for mussels tends to make the mussel merchants and mussel rakers seek to lift mussels before they are completely filled and of a fit size for bait. This is one of the contributing causes to the impoverishment of the Clyde beds.

The Clyde mussel area can be conveniently divided into three portions, grouped round the three chief banks—viz., Pillar Bank, Cockle Bank, and Greenock Bank.

### 1. Pillar Bank.

The Pillar Bank extends seawards along the north-east shore of the Clyde from the town of Dumbarton. Most of the bank is within the limits of the jurisdiction of the Clyde Trustees, but within these limits it is almost entirely unsuitable for the rearing of mussels, the bank being from 1 to 5 feet dry at low springs. The part of the bank which is of interest from a mytiocultural point of view is that below the series of perches in a line between Newark Castle, in Port-Glasgow, and Cardross Burn, in Dumbartonshire. The distance across the river Clyde along this boundary is 1⅝ nautical miles. From the Clyde Trustees' boundary the Pillar Bank stretches, as a tongue-shaped mass, in a north-west direction as far down as in a line from Ardmore Bay to Inchgreen Gas Works, *i.e.*, for more than 1 mile. This is the length of bank which dries at lowest springs; and the breadth of dry bank along the limit of the Clyde Trustees' jurisdiction is about 1 mile. These boundaries give the extent of the Pillar Bank, which dries at lowest springs; but for convenience sake we may also consider with it the submerged continuation of the Pillar Bank, known as the Flats and the Hulloch More. The mussel ground of the Pillar Bank, the Flats, and Hulloch More is, therefore, quite 2½ miles long, and extends in a north-westerly direction as far as Ardmore Head. Along the Dumbartonshire coast the mussel growing area begins a quarter of a mile above the line of Perches in Cardross Bay, dips into Cardross Bay, follows the 5 feet line to opposite Ardmore Tower, and gradually wends outwards to a depth of 12 feet at Ardmore Head. From the last-mentioned point the boundary line curves round, and runs alongside the diagonal deep channel between the Cockle Bank and the Pillar Bank, extending topwards to opposite Port-Glasgow. The upper boundary of the mussel area begins about 200 yards above Perch No. 1, then winds below Perch No. 2 till it is 200 yards below the Clyde Trustees' boundary, and curves upwards after passing No. 3 Perch till it is a quarter of a mile above the boundary opposite Cardross.

The Pillar Bank area may be considered as stretching from Cardross to Ardmore Head, and from the latter, curving along the deep channel, to opposite Port-Glasgow. In this area the only ground quite unsuitable for mussel cultivation is the sand banks of Ardmore Bay, and the sand, which stretches continuously from that bay past the Rifle Target and the Brick Kilns to Cardross Bay. The mussel area is outlined on the accompanying map. (Pl. V.).

Most of this area is covered with mud, and this also is universally the case for the deep running up from Ardmore to Cardross, and the deep from Ardmore Head towards Port-Glasgow, and also for most of the flats. The mud is not so soft and deep as is found on many mussel beds, and at many places it is intermixed with sand. Most of the Pillar Bank that dries is composed of sandy mud, and in some places of sand, but the

substratum is always mud, which is covered by from an inch or two to nearly a foot of sand in some places. Here and there, on the Port-Glasgow side, ballast stones have been deposited, but these ultimately become silted and buried by mud. Around the perches are stones, but the area covered by these is very small.

The Pillar Bank dries at lowest springs from an inch or so to about three feet. With a prevalent south-west wind, not nearly so much of the bank dries, and conversely with north-east to south-east winds the dry area is increased. The tide ebbs for half an hour longer on the Port-Glasgow side of the bank than on the Cardross side; so that, when the bank is drying on the south side, it is being covered by the inflowing tide on the north.

While the above description holds for the general shape and size of the Pillar Bank over a number of years, yet the quantity of silt in the water of the river, and tidal currents alter in time the configuration and size of the bank. In recent years, between the Pillar and the upper end of the Cockle Banks, a small bank about 600 yards long and 200 yards broad has risen. When the last corrections were made on the Admiralty Survey, water covered this bank at low springs to the depth of one foot. This bank, included in the map in the Pillar Bank, lies immediately opposite Port-Glasgow Harbour, its upper end being about 200 yards on the north side of the navigable channel of the Clyde.

As to the present condition of the Pillar Bank, the supply of mussels on the portion that dries is small for the size of the ground capable of fattening mussels. The sand on the lower end, and towards the Cardross side of the dry area, is not suitable at present for a vigorous growth of mussels, but under a system of bed cultivation much of it in time could be utilised, especially in places where but a few inches of sand covers the underlying stratum of mud. Nearly one-half of the dry area might be stocked with mussels, and, with all the other areas stocked, even a portion of the other half might be utilised as a store for mussels afterwards to be shifted to lower ground. During the present season only some 50 tons of mussels have been lifted from the Pillar Bank, but 400 tons have been taken from the flats and the deep off Ardmore. Unfortunately, for an exact representation of the present condition of the flats and deeps, the data are not so easily obtainable as for banks which become dry. However, an examination of the bottom and stock on it by sounding and by raking shows that, while mussels are plentiful in some places, they have been fairly gathered from other submerged areas.

## Cockle Bank.

This bank is also on the north side of the navigable channel, and the whole bank, viz., the dry and submerged portions, is fully a nautical mile in length. The upper end of the bank is near the check, or No. 1 buoy, off Port-Glasgow Harbour, and the lower end is opposite No. 6 buoy, opposite the middle of the new breakwater for the Great Harbour of Greenock. The north-east boundary runs alongside the deep channel between it and the Pillar Bank, and the lower, or north-west limit, is sinuous in outline from opposite No. 6 buoy till it joins the north-eastern boundary. The bank is nearly triangular in shape, with the apex directed up the stream.

About one-half of the bank dries at low springs. The dry area is also triangular in shape, above three-quarters a mile long, and about 600 yards broad. For fully half-a-mile the Cockle Bank—as might be expected from the name—is composed of sand. This sandy area is also triangular,

and its base occupies the base of the dry bank, but, like the sand of the Pillar Bank, it has underneath a substratum of mud. The sand is shelly sand, but on the Greenock side of the bank the sand is much coarser than elsewhere on the bank. On the Greenock side, opposite the east entrance to the Great Harbour, there are heaps of ballast, and gravel also abounds at the same place.

The Cockle Bank dries for three feet opposite the Great Harbour at low springs, but the average height of the dry area is about one foot. On the Ardmore side, there is from three inches to one foot of water on the bank, and at the upper end from one to seven feet at low springs.

There are very few mussels on the lower or sandy end of the bank, but at the upper end, and on the part along the north-easterly side, there is a fair quantity of mussels. The upper end of the bank yielded 250 tons during the past season. The upper end and the Ardmore side of the bank are composed of mud, and good mussels can be obtained from this area.

In addition to lugworm and cockles, the bank is inhabited by such forms as Buccinum and Purpura. The numbers of these forms are few, and even the lugworm and cockles are anything but abundant.

## Greenock Bank.

This bank extends downwards as far as Princes Pier, of the Glasgow and South-Western Railway, to where the deep-water begins at the Tail of the Bank. Its upper boundary may be described nearly as high up as the entrance to the Garvel Basin, and here the bank is separated from what is known locally as Cabbie Low's Bank by one to two feet of water at low springs. The seaward boundary is at the water which stretches from the Tail of the Bank towards Ardmore Tower. Cabbie Low's Bank is practically a portion of the Greenock Bank, although it dries as a separate bank, a quarter of a mile long and 200 yards broad. Indeed, the Greenock Bank may be considered as embracing the whole area upwards from the Tail of the Bank to nearly the low end of the Cockle Bank. The nautical survey does not represent any of the Greenock Bank or of Cabbie Low's Bank as dry at low springs; but, whatever was the condition as to depth when the survey was made, two distinct banks are now dry at low springs, viz., one opposite Custom House Quay, and the other, Cabbie Low's Bank. Whether this is due to an alteration of the level by silting, I cannot say, but that the portions mentioned become dry I had various opportunities of observing.

The portions that dry do not rise above water for more than a few inches. The soil is a sandy mud over the whole extent of the bank, and quantities of Ulvaceæ and *Chorda filum* are found on it. The extended bank is more than a mile and a quarter in length, and the greatest breadth, near the upper end, is three quarters of a mile. The low end of the Greenock Bank is very sandy, and on the side next the navigable channel of the river ballast stones have been deposited. Underneath the sandy parts of the bank there is a regular bed of mud.

During the past season 100 tons of mussels have been lifted off Cabbie Low's Bank, and quantities have been obtained from other parts of the Greenock Bank. As on the Cockle Bank, great destruction of mussels takes place from men and boys tramping over the beds and digging for lugworm. On some of the banks, also, numbers of women gather the edible whelk, and so tramp and bury the mussels under foot. On a well-regulated bed this should be prohibited, as the damage done is much more than all the gain got from the lugworm and the whelks.

### South Side of Channel.

A long narrow strip, from the east end of the James Watt Breakwater upwards to the limit of the jurisdiction of the Clyde Trustees at Newark Castle, is also a mussel-producing area. This area, I have been informed, extended further towards Greenock in former times, but the construction of the James Watt Breakwater has considerably altered the length of the mussel-producing strip. The soil on which the mussels grow is fine mud, and the depth of water over them runs from ten to fifteen feet at low springs. The strip is outlined on the accompanying map, but, besides this strip alongside of the navigable channel, the shallow ground near the timber ponds also bears mussels, but the area here is very restricted.

### Fauna of the Banks.

Besides mussels, the ordinary animals that live in association with them are present on the beds. Amongst the enemies of the mussel are starfish, *Uraster rubens* L., which are obtained in the rakes from the flats and deeps off Ardmore. These are more numerous than the boring Molluscs, which perforate the mussel shell and extract the juices and flesh of the animal. The latter are the 'Dog whelk,' *Purpura lapillus* L., and *Buccinum undatum* L., or 'Buckie.' The edible whelk, *Littorina litorea* L., is found especially on the Cardross side of the upper part of the Pillar Band, and small lugworms, *Arenicola piscatorium* Lamk. are regularly dug for in the muddy sand on all the banks.

Samples of sandy mud were taken from four points, viz., from the Pillar Bank, near the Port-Glasgow edge of it, from the Cockle Bank, from Cabbie Low's Bank, and from the Greenock Bank, at a point opposite Custom House Quay. My colleague, Mr Thomas Scott, F.L.S., has kindly examined the mud, and made lists of the species of Foraminifera and Crustaceans which occurred in the mud. The Foraminifera include four genera and seven species, the Ostracoda seven genera and twenty-four species, and nine genera and nine species of the Copepoda. The following are the lists of these groups :—

#### FORAMINIFERA.

*Miliolina fusca*, Brady.
,, *seminulum* (Linn.)
,, *subrotunda* (Mont.)
*Lituola scorpiurus* (Montfort.)
*Truncatulina lobulata* (Walker.)
*Polystomella striato-punctata* (F. & M.)
,, *crispa*, Linn.

#### OSTRACODA.

*Cythere lutea*, Müller.
,, *pellucida*, Baird.
,, *confusa*, Brady and Norman.
,, *porcellanea*, Brady.
,, *villosa* (G. O. Sars.)
,, *pulchella*, Brady.
,, *concinna*, Rupert Jones.
,, *angulata* (G. O. Sars.)
,, *dunelmensis* (Norman.)
*Cytheridea torosa* (Jones.)
*Eucythere declivis* (Norman.)
*Loxoconcha viridis* (Müller.)
*Loxoconcha pusilla*, Brady & Robertson.
,, *tamarindus* (Jones.)
,, *fragilis*, G. O. Sars.
*Cytherura gibba* (Müller.)
,, *sella*, G. O. Sars.
,, *angulata*, Brady.
,, *undata*, G. O. Sars.
,, *nigrescens* (Baird.)
,, *fulva*, Brady and Robertson.
*Cytherois fischeri* (G. O. Sars.)
*Paradoxostoma abbreviatum*, G. O. Sars.
,, *variabile* (Baird.)

#### COPEPODA.

*Pseudocalanus elongatus*, Boeck.
*Cyclops æquoreus*, Fischer.
*Ectinosoma melaniceps*, Boeck.
*Ameira longipes*, Boeck.
*Mesochra lilljeborgii*, Boeck.
*Laophonte lamellifera*, Claus.
*Thalestris harpactoides*, Boeck.
*Harpacticus chelifer* (Müller.)
*Idya furcata* (Baird.)

The Cockle Bank shows the greatest number of species of Ostracoda, the Greenock Bank of Foraminifera, and the Pillar Bank of Copepoda. The following is the tabulated result for the whole, and for each of the four places from which mud was taken :—

| | Foraminifera. | | Ostracoda. | | Copepoda. | |
|---|---|---|---|---|---|---|
| | Genera. | Species. | Genera. | Species. | Genera. | Species. |
| Clyde, | 4 | 7 | 7 | 24 | 9 | 9 |
| Pillar Bank, | 2 | 2 | 5 | 13 | 4 | 4 |
| Greenock Bank, | 3 | 5 | 4 | 13 | 1 | 1 |
| Cockle Bank, | 2 | 4 | 6 | 17 | 3 | 3 |
| Cabbie Low's Bank, | 1 | 1 | 5 | 10 | 2 | 2 |

It may be of interest to compare these results with these tabulated for the Montrose Banks. Of Foraminifera, 12 genera and 20 species were obtained from Montrose, as against 4 genera and 7 species for the Clyde. All the genera of the Clyde were found at Montrose, and the species common to both were 2 *Miliolina*, 1 each *Truncatulina* and *Polystomella*. Of Ostracoda, Montrose furnished 6 genera and 18 species, as against 7 genera and 24 species for the Clyde. Only 1 Montrose genus was not obtained from the Clyde mud samples, while 4 *Cythere*, 3 *Loxoconcha*, 2 *Cytherura*, and 1 *Paradoxostoma* were common to both. Three genera and three species of Copepoda were obtained from the Montrose mud, and only the burrowing form, *Ectinosoma melaniceps*, was common to both places. Nine genera and 9 species were furnished by the Clyde.

## How to Increase the Supply of Mussels.

While the state of the law, and the methods of fishing the Clyde mussel beds remain as at present, no great increase of yield of mussels can be looked for. By careful cultivation and wisely enforced regulations, the beds might be made to yield a regular supply of well filled mature mussels far in excess of the quantities which have yet been obtained from them.

In any operations which may be conducted, nothing ought to be done which will in any way affect the navigation of the river ; and if the beds are farmed on approved and established principles of culture, nothing can be done that will be prejudicial to navigation. Besides, the depositing of ballast on any of the banks or flats ought to be strictly prohibited. Not only does ballast take up room where mussel cultivation aims to have mud, but its presence tends to heighten the level of the banks, and so restricts the area of first-class growing ground.

The beds are worked at present almost exclusively from Port-Glasgow, where the Caledonian Railway have rails laid on the quay beside the place at which the mussels are landed. This enables the mussel fisherman to ship his mussels from the boat side for Moray Firth, Eyemouth, and East Coast fishing ports. The boats employed for transporting the mussels from the banks are ship's old boats, capable of carrying almost two or three tons of mussels. These boats are owned by mussel merchants resident in Port-Glasgow, and are worked by mussel fishermen, who are natives of the northern counties of Ireland. The arrangement is that the merchants supply the boat and gear to the fishermen who receive,

generally, ten shillings for each ton of mature mussels landed and trucked at Port-Glasgow. The fishermen gather the mussels by means of rakes, similar to those used at Montrose and the Eden, and they work from half ebb tide to half flood tide.

The present arrangement, where there is competition between the merchants and between their fishermen, has an inevitable tendency to over-fishing, and to the taking of mussels which are not of sufficient bait size. The demand, too, for mussels also tends to accentuate this over-fishing, and to the despatch of mussels which ought to remain for at least a year longer on the beds. Free fishing also hinders anything of the nature of seeding, or of rotation of crop being attempted, for nobody will seed beds which any one can strip of its mussels.

How, therefore, can cultivation be inaugurated for these valuable beds? Free fishing is absolutely fatal to cultivation. The only other alternative is by the Fishery Board granting a several fishery order for the whole or part of them, and ensuring to the cultivator or cultivators the results of his or their operations. The grantee could then cultivate the seeds to advantage, and would also be in a position to pay a fair royalty for the privileges which he enjoyed should this course be found desirable and competent.

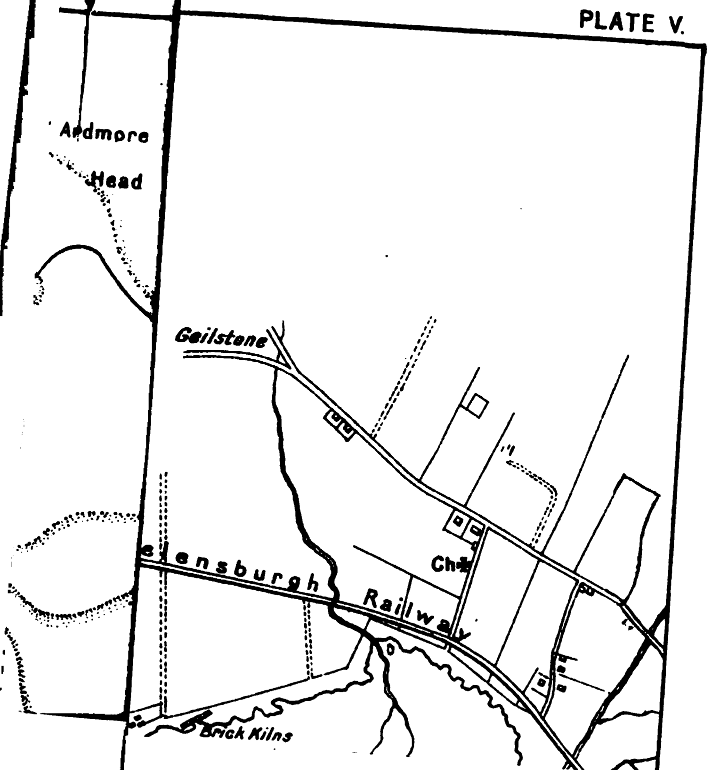
The differences between the present system of no-culture and cultivation would be that the grantee would find it to his own advantage to assist nature, and transfer the seed from the lower reaches of his ground, where it settles in more abundance, to the better growing ground, where the water is not so salt. At present the banks are allowed to seed themselves, and the mussels consequently take a longer time to cover the bared banks. The time which the more intelligent fishermen declare that it takes the Clyde mussels to reach maturity is four to six years. But by cultivation this time would be considerably shortened by the lifting and re-sowing of the mussel seed. It is quite as necessary to thin mussel seed as it is to thin turnips, or to thin the trees of a young plantation; and it is as absurd to sow turnip seed and look for a matured root crop without further work, as to expect well filled, large, and mature mussels from seed that remains *in situ*.

The first necessary operation, therefore, for the mussel cultivator of the Clyde beds is, after the ground has been stripped of the mature forms, and the banks have attained the proper decrease in height, to bring a supply of seed mussels of at least half-an-inch in length, and sow them on this ground. This may be called the preliminary operation in all successful mussel culture.

The condition of the other mussel banks, and the supply of seed will determine the succeeding steps to be taken. Where the supply of seed within a reasonable distance of the beds is ample, the difficulty may be to find sufficient ground to receive the young mussels. In such a case it is better to allow the seed to remain on the seeding beds till the mussels have attained a larger size than the minimum size, when they may be shifted with impunity. By permitting the half-inch mussels to remain *in situ*, they soon grow so as to attain the size of an inch. These latter bear transport better than the smaller size, and on the same bank they grow quite as well, and sometimes even better than the smaller forms. Where the supply of seed is deficient, operations become more expensive, and the beds are not so remunerative. In the Clyde, however, there is a plentiful supply of seed, and the same difficulties have not to be contended with as at Montrose.

In all mussel areas some banks are better growing than others. In the Clyde the best growing ground is at Ardmore deep, and on the flats, where the ground seeds itself, and the mussels are lifted when four years old. If, in this place, the mussels were thinned, there is no reason why

PLATE V.



Ardmore
Head
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where the g
old. If, in

there is no reason why

the crop should not be mature sooner than in four years, or the mussels, after four years' growth, would be larger than those obtainable now from the flats and Ardmore deep. It is usual to transfer seed to the higher banks; and, as the lower and better growing banks are depleted to re-transfer this seed from the higher banks, where it was deposited, let us say, one year previously. In the bed system, the reverse to the bouchôt process is found to answer better for our conditions of climate and water. In the Bouchôt system the mussels are transferred from the more seaward *Bouchôts d'Aval* towards the *Bouchôts d'Amont;* while, under the bed system, the mussels are transferred from the more seaward and deeper seed ground to the higher banks, and then, if a transference is desirable, to the better growing and lower banks.

## Conclusion.

The Clyde beds are amongst the most valuable mussel beds in Scotland, and are capable of producing a much more abundant crop than is yearly got from them, and so increasing the supply of mussels which, moreover, can be reared very economically. So long as matters remain as at present, the tendency will be towards lifting the mussels before they grow to a size suitable and sufficient for the fishermen. Perhaps quite as much as any place in Scotland, it is necessary to make and enforce regulations for the proper cultivation of the Clyde beds. Till this is done, and till it is to the interest of the men working the beds, not to lift the mussels till they are of a sufficient size, little will be done to augment the mussel supply.

In cultivation it will be necessary to gather the seed from the portions of the banks which form a catchment area, and to transfer it to the beds, where the mussels will grow and fatten. When this is done the Clyde will contribute its share to lessen the mussel famine, and to supply cheap bait to a most deserving class—the line fishermen of Scotland.

## V.—THE FISHERIES OF SHETLAND.

By Robert Duthie, Assistant Fishery Officer.*

From their position and configuration the Shetland isles are admirably suited for the seat of a great fishery, and they have been so from time immemorial. It is well known that Dutch vessels visited the islands regularly for centuries in the prosecution of the herring fishing; and, among other strangers, Irish smacks came to engage in the cod fishing about the end of the last century.

Except trawling, for which a good deal of the sea bottom is unsuitable, all methods of fishing are brought into operation and all sizes of boats used—from the small hand line skiff with its crew of two, to the steam liner or the cod smack of 70 tons register and crew of 15 men.

*Vessels.*—Of the fleet of fishing-smacks annually fitted out, the larger sized—say from 40 to 70 tons register—go to Faröe, Rockall, and Iceland; while the smaller vessels of from 15 to 35 tons work on the banks round Foula. Occasionally the crews of these vessels are engaged at a weekly rate of wages, but the general rule is to engage by the share, the owners of the vessel receiving one-half of the proceeds of the voyage and the crew the other, which is divided according to a fixed scale, by which the master and mate receive extra allowances. As an encouragement, the fishermen are generally paid a small premium for each score of cod they catch, and the reckoning is kept by a rather peculiar method. The fisherman cuts off the 'beard' or feeler from the lower lip of each fish he hauls aboard, and these he subsequently counts out to the skipper.

*Boats.*—Of the fishing boats of all classes a great number are owned by the fishermen, who have in some cases been assisted by loans granted by the Fishery Board under the Crofters Holdings (Scotland) Act of 1886. In boats owned by curers and merchants, the crews go upon the half-catch system. Early each year the curers engage their required number of large-decked, deep-sea boats for the spring cod and ling fishing at a special rate per cwt. for each kind of fish landed, the fish being 'headed and gutted' before they are weighed. The terms thus made also apply to smaller boats. The prices for 1891 were:—Cod and ling 7s., tusk 4s. 6d., and saithe 2s. 6d. per cwt. For halibut the price was 10s. per cwt. up to the end of March, 8s. for April and May, and 6s. during the rest of the summer. In the winter months, when halibut are scarce and more easily preserved, higher prices are paid.

*Fishing Grounds.*—In glancing at a chart of the Shetland islands (see page 182 of Part III. of Board's Report for 1890), it will be seen that from 27 to 30 miles off the West Coast, the ground, which has a uniform depth of from 90 to 60 fathoms shorewards along the whole length of the islands, dips sharply to from 200 to upwards of 600 fathoms. Along this slope is the best halibut fishing ground in Shetland; and since the adjacent deep water cannot be fished, the supply is practically inexhaustible. Hauls of 5 or 6 tons of halibut are sometimes got there with one dip of the lines, if fishermen can get them warped along the slope. All the distance shorewards from this line the ground is good for long line fishing; and herrings are usually abundant in June generally within a few miles of the coast. Along the North Coast the fishing grounds extend to about 40 miles off, but as you turn eastwards the 100 fathom-limit recedes from the coast till on an easterly course from Skerries it is 100 miles from land.

* I am much indebted to Mr Millikin, the District Fishery Officer, for much valuable assistance in the preparation of this account.

## 1. Cod and Ling Fishery.

The staple industry of these islands has, for generations been cod and ling fishing and curing. Early in the century, when Government bounty was paid upon dry fish officially stamped, this trade was of sufficient magnitude to require the services of four or five fishery officers, who were stationed at various places among the islands.

### *Hand Line Fishing.*

A very extensive handline fishing is carried on by the Shetlanders, both on the inshore grounds and the deep-sea banks.

Cod fishing and curing aboard smacks at Faröe, Rockall, and Iceland, used to be a far larger trade than it is now. In its palmy days—from 1860 to 1880—from 60 to 70 Shetland vessels were annually fitted out, and from 20 to 40 English smacks disposed of their fish to Shetland merchants. Since then the numbers have been gradually decreasing. In 1891 only 11 English and 21 local crafts were employed in this branch of the fishing.

About the end of February some of the largest of these smacks are fitted out for Faröe and Rockall. At that early season the weather is usually rough, and the fishing very uncertain; with a few good days a full ship is sometimes obtained, while in rough weather they may have to lie to for weeks doing nothing. About the month of August, unless prospects are very good at Faröe or Rockall, these large smacks proceed to Iceland, where a full cargo is generally obtained if the weather prove favourable. In 1887 two vessels owned by one firm landed between them 92,000 fish, representing a value of about £5,500. One had made four and the other five trips to Rockall. Most of these large smacks have wells, in which, on their last trip for the season, they carry live cod to Grimsby.

The smaller smacks, from 15 to 35 tons, are not usually fitted out till May, and confine their operations to the Foula Bank. In all these vessels hand lines with two hooks are worked, and the bait used is mussels, which are salted for the longer voyages.

Hand line fishing in small boats is carried on all round the coasts of Shetland, when weather permits. Cod are the fish most sought after, but considerable quantities of haddocks, tusk, ling, and saithe are also caught. About the southern extremity of the islands the saithe fishing is vigorously prosecuted in these small hand line skiffs, and large quantities are annually cured in that part of the district. The inhabitants of Fair Isle confine themselves almost exclusively to this branch of the fishing. Saithe are abundant at other places in the district, but as they are of comparatively little value, they are rather neglected by fishermen. The lines and bait used in these small boats are the same as in the Faröe smacks.

### *Long Line Fishing.*

This fishing may by said to commence annually in the month of February, among the islands in the neighbourhood of Scalloway. Regularly every year, great numbers of cod gather among these islands during the spawning season. The fishermen then work their long lines in small 'four-oar' boats, and the fish are often so plentiful that boats are loaded off half the fleet of lines, and two trips have to be made before lines and fish can be all landed. Not far off these islands there is said to be a shallow ridge with about 12 fathoms water, inside of which the

depth is much greater. In westerly gales the cod came over this ridge, into the deep still water inside, and they either cannot or will not return to the open sea till they have spawned. Any season that the fishing is exceptionally heavy the fish are generally in poor condition, the opinion of fishermen being that the ordinary supply of food is not sufficient for the number of fish on the ground. The small boats engaged in this fishing carry an average of 6,000 yards of lines, with a total of 1,000 hooks, and the bait used is the large Shetland mussels, locally known as 'yogs.' For the 10 or 12 weeks that this fishing lasts, a crew of five men usually land from 400 to 600 cwts. of fish if the season be a good one. Most of the 'Greatline' or Long Line Fishing about Shetland is now done in large decked boats of from 45 to 50 feet of keel, manned by at least six men, and carrying from 16,000 to 26,000 yards of lines. The total number of hooks on these would be from 2,500 to 4,500. Each boat carries from a dozen to 20 nets with which to catch herrings for bait. The fishing grounds worked on extend on the West and North Coast to the 100 fathom-line, but this limit is seldom reached on the East Coast, on account of its greater distance from land. Of 170 boats employed last year (1891) 120 were owned and manned by natives; and the rest hailed mostly from Aberdeenshire and Banffshire. The fishing usually commences about the first of March, and is prosecuted with great vigour till the end of May, when most of the crews give it up and commence the herring fishing.

In a good season a crew's gross earnings range from £150 to £200, but as much as £240 has been earned by a crew for six weeks' fishing.

The 'sixerns' or open six-oar boats, which were in danger of becoming obsolete, have been regaining favour recently, and a good many new crafts of this description are being built.* They are from 20 to 25 feet of keel, with sterns considerably raked, making the extreme length five or six feet more, rather shallow, and of sharp build. They are cheap, light to work, and draw so little water that they can be used with advantage at places where larger boats could not with safety be employed. They are manned by a crew of six, and carry an average of 8,000 yards of lines with a total of 1,300 hooks. If obtainable, herrings are used for bait, otherwise sillocks, or part of the fish they catch. Halibut were very much used for bait before fresh fish were exported from the islands. The 'sixerns' commence fishing in May and work till the middle of August. In moderate weather the Shetland fishermen go a long distance to sea in these boats.

Small boats locally known as 'four-oars' are also used in the long line fishing, but, except at Scalloway, not to any great extent.

Until 1876–80, when East Coast fishermen began to come to Shetland, the natives were content to work on the same lines as their forefathers had done, without the least change in the style of boats, material, dates, or methods of fishing. So far as known, on no occasion was there ever more than 70 cwts. of fish landed from a 'sixern' for one trip. Since the large-decked boats came into general use such a take would be considered rather a low average in good weather, and no less than 240 cwts. have been landed for one trip. Last summer two boats fishing at Ronasvoe landed 31 tons of fish, worth £200, in a week—the one having 17 and the other 14 tons—but each made two trips to the fishing grounds.

The change thus effected has fully met the decrease in the deep-sea fishing aboard smacks, and the result is that, during the past half century,

* The 'sixerns' and smaller boats used in Shetland are all built on the Norwegian model. Until some time into the present century, boats used to be brought from Norway in sections and put together in Shetland. A few small skiffs are still annually imported from Norway, but these are brought ready for sea.

the quantity of cod, &c. cured dry has shown a steady increase. Poor seasons have occasionally intervened, but the general progress of the industry has been unmistakeable. The following figures show the yearly averages for the last five decades :—

| Years, | Yearly average. |
|---|---|
| 1840–49 | 37,850 cwts. of dry fish. |
| 1850–59 | 43,750 " " |
| 1860–69 | 61,400 " " |
| 1870–79 | 85,990 " " |
| 1880–89 | 67,800 " " |

The abnormal increase in 1870–79 deserves some explanation. About that time the demand for Shetland cured fish was greater than the supply, and local merchants began to import, in a half-cured condition, considerable quantities of Norwegian cod, which were then dried and exported as Shetland fish. The experiment did not prove a lasting success, and was finally abandoned.

### 2. Haddock Fishing.

This is the chief occupation of the Shetland fishermen from the end of September to the commencement of the cod and ling fishing. The chief seat of the fishery is about Scalloway and the adjacent isles, but it is carried on more or less round the coast, wherever there is a safe harbour and steam communication. Mussels are the principal bait, but cockles are also freely used, especially in the North Isles. The fishing grounds are in every case close to the shore,—often land-locked by islands. The boats used are light four-oar skiffs of 14 or 15 feet of keel, modelled like the 'sixerns.' The crew of four or five men carry lines similar to those used on the East Coast of Scotland.

Before increased steam communication put the Shetlanders in touch with the fresh-fish markets, all that could be done with haddocks was to cure and dry them like cod, and the price was too low to encourage fishermen to work. This is, therefore, quite a recent industry that has grown up within the last decade. From 1884—when authentic records of haddock fishing were first kept—to 1888, the yearly total steadily increased from 12,726 cwts. to 28,056 cwts.; but since then, from whatever cause, there has been a gradual falling-off to 12,884 cwts. in 1891. Fortunately the price paid to fishermen has been steadily increasing, and their earnings have not been reduced in proportion to the catch. Scalloway and Burra Isles crews often earn £20 a man for the season of about four months.

Very few of the haddocks are smoked in Shetland: the bulk of them are sent south in ice.

### 3. Herring Fishing.

Of all the fishings carried on in Shetland, the herring fishing is the most fluctuating. In the year 1834 the fishing was a failure on the East Coast of Scotland, but herrings were abundant at Shetland—one firm having cured and branded no fewer than 20,000 barrels, and the total for the district amounting to 57,000 barrels for the season. After this, from various causes, the fishing declined very much. For the long period of 40 years the total only once reached 20,000 barrels (in 1841); and it was generally from 1,000 to 10,000 barrels a year. The lowest recorded figures are for 1864, when the season's cure only came to 658 barrels. From 1870 to 1879 the average yearly total was under 4,000 barrels.

In 1876, 11 Banffshire crews tried the cod and ling fishing at Shetland, and their success was such as to induce them to return annually in increased numbers. 'Sixerns' had formerly been almost the only boats used in the herring and longline fisheries, and the Shetland fishermen did not think the local grounds could be conveniently worked in larger boats; but the success of the strangers changed their ideas. The great disaster of 1881 (in which 61 lives were lost) gave them an increased dislike for the 'sixerns,' and the prosperity of the herring fishing made it possible for a good many of them to provide themselves with boats like those used by the East Coast fishermen.

From 1880 to 1885 the development of the fishing was altogether phenomenal.

| | Barrels cured. |
|---|---|
| 1879, | 8,755 |
| 1880, | 48,552 |
| 1881, | 59,586 |
| 1882, | 134,187 |
| 1883, | 256,487 |
| 1884, | 300,117 |
| 1885, | 369,895 |

Since 1885 the fishings have been very irregular, and the results often disappointing to all concerned. Dog-fish have been the chief cause of failure, but another reason, no doubt, is the great depth of the water in which the fishing is carried on. Even on banks where the depth is only 20 or 30 fathoms, as in the Moray Firth, the herring-shoals do not always rise, when it is well known that they are on the ground—their movements being, no doubt, affected by the weather, the tides, or the movements of the fry upon which they may be feeding. Their habits would naturally be much more irregular where the depth is two or three times as great.

In Shetland there are two distinct herring fishings. The early fishing is carried on along the West Coast and around the North Isles, from the middle of June to the middle of July. Of 514 boats employed in 1891, less than half were owned and manned by natives, and the rest came from various places along the East Coast of Scotland, or from the Orkney Islands. East Coast fishermen show pronounced preferences for particular stations. From the Montrose, Fraserburgh, and Banff districts the fishermen go almost exclusively to Baltasound, while those from Peterhead and the adjacent villages go regularly to Cullivoe, Whalfirth, and Ronasvoe. This selection is not brought about by the curers so much as by the fishermen's own inclinations.

The herrings caught during the early season are rich and well-flavoured, but they have not, generally, melt and roe well developed, and, therefore, are not officially branded.

Spent herrings are found on the grounds in May; small young herrings early in June; and these again are replaced as the month advances, sometimes apparently in a night, by a larger race of fish, which, in turn, often disappear as suddenly as they came. Swedish fishermen often say they get numbers of large herrings in the stomachs of cod and ling caught in the deep water off Unst, after the British fishermen cease to get any in their nets.

There is generally a period of three or four weeks before the 8th or 10th August that no herrings are got about the North Isles, and, on account of this time of enforced idleness, East Coast fishermen give up fishing and go home about the middle of July.

The late fishing is carried on all along the east coast of the islands, from

Unst to Sumburgh Head. Its headquarters is Lerwick, and of recent years the fishing is being concentrated there more and more. A commencement is made about the 20th of July, and the fishing is generally continued till the middle of September. Of 310 boats engaged in 1891, at least three-fourths were owned and manned by natives; and the rest, with one or two exceptions, were from Manx or Irish ports.

The herring-nets used by the Shetlanders are 60 yards long and 18 score (of meshes) deep; and of these each boat carries from 35 to 40. The few 'sixerns' that are still used carry from 12 to 15 nets.

The fishing grounds extend about 40 miles seawards, but most of the herrings are caught 10 or 12 miles off the land, in a south-easterly direction from Lerwick.

For both the early and late herring fishings the boats have always hitherto been engaged at a fixed rate per cran; the system of selling daily by auction has not yet been introduced into Shetland.

Mackerel are often plentiful about the North Isles and other parts of Shetland in the months of July and August. No regular fishing is carried on, but hauls of as high as 8 or 10 crans have been got in herring-nets. The mackerels are usually very large and rather coarse. On account of the long distance from any fresh market, they are of little value, and sometimes go for manure. Mackerel curing, which has grown to be an important industry about the south-west of Ireland, has not been tried here.

### 4. Sillock Fishing.

'Sillock' fishing in Shetland deserves a passing notice. The term 'sillock' is applied to the young saithe in the second year of their growth, when they form a considerable part of the food of the Shetland fishermen during the winter months. They are caught in various ways, but chiefly on 'flies' or in 'pock' or hand-nets. The first of these methods needs no description, except that the flies used are of white feathers. The 'pock-nets'* are woven in the shape of a trout-landing-net, round stout iron rings of from 4 to 6 feet in diameter. Bait may be attached as a lure, but is seldom necessary, as cormorants are constantly hunting the sillock shoals into narrow creeks. There the fishermen lower their nets to the bottom, suspended from short stout rods, and as soon as a sufficient number of sillocks come above the net it is hauled up, the fish in their haste to escape usually going down into the net, instead of over it. From 1 qr. to 1 cwt. may thus be taken at a haul; and skiff loads are daily retailed at Lerwick Pier during the winter at about 1d. a gallon. As an article of food they are of no market value, except in Shetland, but a good many are converted into manure in the local factories; and in some places they are caught solely for their livers, from which oil is extracted. From Skerries 200 barrels of sillock oil have been exported in one winter. The waste of fish thus caused must have been enormous.

### Hindrances to Fishing.

*Dog-fish.*—The greatest hindrance to the success of the herring fishing about Shetland has hitherto been the visits to these shores of large shoals of dog-fish, that come with almost annual regularity. They always appear first on the west side of the islands, and as a rule gradually spread

* These 'pock-nets' are sometimes used for the capture of herrings. In the autumn shoals of herrings are driven by saithes into narrow voes, where they are packed so close that fishermen fill their small boats by means of these nets. Occasionally *baskets* are used.

round the north and east coasts. Various theories have been put forward in explanation of their visits. A very plausible one is, that they come along in the course of the gulf stream till they meet the western coasts of the British Isles; and that this is why the fishing grounds about the Outer Hebrides, Orkney, and Shetland are so often overrun by them. Some seasons they seem to approach Shetland from the deep water to the northwest of Unst and Yell; at other times they appear first about Orkney and the progress of the shoal northeastwards may then be clearly traced by fishermen, and their arrival anticipated.

The spring cod and ling fishing suffers at times from their ravages, but their visits are most frequent during the early herring fishing in June and July—just when they are least welcome. They are often so plentiful at that season that fishermen may sail for miles and find the sea swarming with them everywhere. It has now come to be understood that if dog-fish appear in large numbers on the coast, fishermen will be allowed to get quit of their engagements and leave the district, as persistent fishing in such circumstances would only ruin them without doing any good to the curers.

As the summer advances the shoal often spreads southwards along the east side of the islands, and becomes equally troublesome during the autumn herring fishing, of which Lerwick is the centre.

From the fact that winter fishing is confined pretty much to land-locked waters in Shetland, the movements of the dog-fish shoals are not so clearly defined after the close of the herring fishing. It is believed that some seasons they remain off and on about the islands all the year round; but usually they disappear from the coast when the cold weather sets in, very few being then seen by the haddock fishers.

*Cuttle-fish.*—Cuttle-fish are another pest from which Shetland fishermen often suffer a great deal. They abound in the waters around these islands, and are often very troublesome during the herring fishing season, though they do not destroy the nets as dog-fish do. They fasten upon the back of the herring after it has been meshed in the net, and with their parrot-like beaks pick out the best part of the fish. In 1886 they swarmed about the islands all summer, and practically caused a failure of the autumn herring fishing along the north and east coasts, crews that had set nets in their vicinity usually bringing ashore more broken than sound herrings. During a gale in September of that year, tons of cuttle-fish were cast ashore on the beaches to the southwards of Lerwick, thus providing a feast for the gulls for many a day.

Cuttles readily attack haddocks and other fish when they find them hooked upon lines; but by line fishermen they are not looked upon as an unmitigated evil, on account of their value as bait. Towards the end of the year they often come into Lerwick Harbour in shoals, and may be frequently seen swimming near the piers, attracted very likely by the 'sillocks' that frequent the sound. Numbers of them are then caught by the fishermen, to be used for bait, the mode of capture being as follows:—Several large hooks are fastened to the end of a rod, which is let down into the water with a 'sillock' suspended above the hooks. When the cuttle, or 'skeetick,' as it is locally termed, seizes this bait, an upward motion of the rod impales it upon the hooks.

Their value as a bait seems to be derived chiefly from the brilliant phosphoric light that shines about their bodies in the dark. This is particularly noticeable about their eyes, which are large and very expressive. In the transparent water about Shetland they can be seen at a great depth. When being hauled up on a line, and spinning round in its efforts to escape, the cuttle's eyes are never for a moment taken off its

captor, but seem to follow his every motion. When cuttles are cut up and used as bait, fishermen say that cod select the heads much more readily than any other part of the body, and they can only account for this by the brilliancy of their eyes.

### FOREIGN FISHERMEN.

*Dutchmen.*—Of the foreign fishermen—one might even say of all the strangers who annually visit Shetland—the Dutchmen are the most familiar figures. Various accounts are extant regarding the extent of the Dutch fishing industry in Shetland waters, centuries ago, but it might not be safe to accept as genuine all the statements thus made. In 1633, as the result of an inquiry on the subject, it was stated that 1500 Dutch vessels were engaged in the herring fishing about Shetland. In the beginning of the 18th century, some French men-of-war burnt and destroyed over 400 of the Dutch fishing vessels in Bressay Sound, after which the fleet was for a long time much reduced. Of recent years the number of these vessels annually fitted out by Holland has been between 400 and 500.

Perhaps no class of fishermen have been so conservative as the Dutch. Until very recently, they continued to work in the same style of boats, methods of fishing, and mode of despatching fish to market as their forefathers did in the days when the English admiral Blake (in 1652) captured the Dutch herring fleet in the North Sea, destroying their escort and confiscating a tenth part of the herrings they had caught and cured. Of the boats presently in use, the old-fashioned 'bom schuits' are flat, square-built, slow-sailing vessels of from 35 to 45 tons, manned by a crew of 9. These are now fast being replaced by large powerful smacks of from 60 to 80 tons register, carrying 14 or 15 men and boys. A good many vessels of this description have lately been purchased from British owners; and the Dutch are building finely modelled crafts of the same pattern—steel being in some cases used in their construction.

There has also been a change in the mode of dispatching fish to market. A few sailing vessels called 'jagers' used to accompany the 'busses' to the fishing grounds, and collect the first cured fish, with which they ran to Holland.

In 1885, some of the fishing companies combined to send steam carriers to Shetland, and several of these have since come annually for the first few weeks of the fishing. They anchor in Bressay Sound, and the fishermen bring in their cargoes for transhipment. In 1891, 153 fishing crafts thus transhipped cured herrings in Lerwick Harbour, and 47 Dutch vessels, other than the above, put in during the fishing season. A good many barrels of early cured Dutch herrings are now sent to Leith in the mail steamers for transhipment to Rotterdam, &c. As in former years, the fishing vessels generally go home with their catches as the season advances.

*Frenchmen.*—Very few French fishermen visit Shetland. In 1891 two were reported at Lerwick Custom House—one of them being on the way to Iceland.

*Swedes.*—About the middle of the last decade, Swedish fishermen first made their appearance in Shetland waters in the prosecution of the cod and ling fishing, and they have since been annual visitors.

Their vessels are a little like the old Dutch 'busses,' but are of a smarter build. The usual size is from 18 to 24 tons register, with a crew of 12 or 13 men, but smaller vessels occasionally come. They carry good-sized skiffs, in which they do the most of their fishing in moderate weather.

The principal difference in the modes of fishing followed by Swedish and Scotch fishermen lies in the way they rig their lines. Although the 'back' of the Swedish line is usually heavier than the Scotch, the 'snoods' and hooks are much smaller and lighter. About a foot above the hook the Swede fastens a small piece of very light wood, which is said to keep the bait above the ground, thus making it more attractive, and keeping it from being slimed up if the bottom is muddy. This wood is got in Prussia, and resembles alder in colour. The pieces used are triangular strips of 4 or 5 inches long, and not exceeding an inch broad at the base. Glass balls are also used at intervals, but they seem to be intended for distinguishing marks rather than floats.

Scotch fishermen sometimes think that where the ground is muddy and the water very deep the Swedes catch twice as many fish as they can do. If this is so, it is to be regretted that our own fishermen have not given this plan a thorough trial, which, so far as can be learned, has not been done.

The Swedes begin to arrive in April, and continue to work about Shetland till the end of August In 1891, 8 of them discharged fish in Shetland, and perhaps as many more fished in the neighbourhood—their chief resort being to the edge of the deep water from 30 to 40 miles off Unst. They frequent Baltasound, partly for the purpose of purchasing herrings for bait; if none are obtainable they use haddocks.

Some of these Swedes sell part of their fish to Shetland curers, and, judging by the takes thus landed, they must do very well. They generally remain at sea most of a week, and for one such trip over £100 has been made, while from £50 to £70 is not uncommon in good weather. As they all make repeated runs home during the summer, and never sell any *tusk* in Shetland, it would be impossible to give accurate figures, but the following was paid to three crews by a local merchant in 1888.

| | | | | |
|---|---|---|---|---|
| To one vessel for | 4 | trips, | . . | £223. |
| „ another „ | 3 | „ | . . | £167. |
| „ another „ | 2 | „ | . . | £135. |

In the face of such figures it may be questioned whether Scotch fishermen would not do better in Shetland with their lines than with their nets in June and July.

# SECTION B.—BIOLOGICAL INVESTIGATIONS.

## I.—ON THE FOOD OF FISHES.

By W. Ramsay Smith, M.B., C.M., B.Sc.

This Report gives a statement of a fourth year's investigations carried out on board the 'Garland' by Mr Thomas Scott, F.L.S. The results are set forth in a way similar to what was done in the case of the three previous years; and, so far, they give a general indication of the relation of this year's investigations to those of previous years. But the published results give little idea of the amount of material available for study, both in Mr Scott's painstaking and comprehensive returns, and in the abstracts I have had to make of his returns for the purpose of preparing the results published in the Annual Reports. The abstracts show not only the species on which the various kinds of fish feed, but also the numbers of fish examined at each particular station, the number containing food, and a list of the various species constituting such food. From this it will be evident that almost any question relative to the dietary of any species of fish at any station and for any month of the year, can be solved by consulting the abstracts. To make a comprehensive study and a digest of all those abstracts would entail an amount of labour, and such a lengthened report as is at the present time out of the question. I may say, however, especially since former Reports are being referred to and used for purposes of comparison by naturalists and others engaged in investigations elsewhere, that many things that are only hinted at, or given without much detail, can be elucidated by reference to the original abstracts. The value of a series of observations made with such accuracy as Mr Scott's have been, and made continuously at fixed stations for a period of four years, can scarcely be overestimated, especially when the numbers of fish examined are taken into account. Hitherto, when the subject of the food of any particular kind of fish has been referred to, the stomach of a single fish in many cases has furnished the sole evidence. More rarely, as in Mr Sim's investigations, a number, sometimes a fairly large and representative number, have been examined. Yet again, systematic investigation has been carried out at definite stations as in the case of Mr Cunningham's investigations at Plymouth, and Mr Holt's investigations on the Irish Coast. All these are useful in themselves as an indication of what fish in their native element may eat or do eat, also for comparison in various ways. But I would point out that the way of statistics is a very hard one, and one in which it is easy to stray. Putting aside for the moment the question of time and space distribution of fish food, and looking merely at the problem of 'What does a fish, say a cod, eat—to judge from an examination of a number of specimens?' one has to face the question of the trustworthiness of the results and of the reasoning. I mean, Can one draw any trustworthy conclusion from ten fish? If not, then from a hundred? Or from a thousand? The law of statistics is very definite, although it is too often unknown or ignored. Let me apply it to a particular case, a

hypothetical one, in reference to fish food. Suppose that 100 cod were examined and that 25 of these were found to contain annelids. By *Poisson's Rule* the degree of the limits of error may be ascertained. Let $M$ = total number of cases recorded in the series of observations (100); $m$ = the number of cases in one group (25); $n$ = the number of cases in the other group (75). Then $m+n=M$, and $\frac{m}{M}$ and $\frac{n}{M}$ are the proportions of each group to the whole. But in another series of 100 observations, made say in similar circumstances, the proportion may be

$$\frac{m}{M}+2\sqrt{\frac{2.m.n}{M^3}};\ or\ \frac{m}{M}-2\sqrt{\frac{2.m.n}{M^3}}.$$

That is to say, working out this in values, that in another series of 100 observations the number of cod containing annelids instead of being 25 may be as many as 37, or as few as 13—a variation of nearly 50 per cent. of the actual number found. If, however, instead of 100 cod having been examined, there had been 10,000 examined, the limit of error would have been only a little more than 1 per cent. above or below the proportion actually found. From this it is evident that observations made on a very small number of fish are of little value, *so far as regards general conclusions* from the observations. This fact I have kept constantly in mind, and in recording small numbers of fish examined, I have forborne to draw any conclusions whatever. Without considering fully the subject of time and space distribution of food, I would give here some of the collective results of the four years' investigations of, What do fish eat?

## FIRTH OF FORTH.

### Plaice.

In all 1205 were examined in the Firth of Forth, of these 883 contained food material that could be identified.

*Echinoderms* were found in 89 stomachs (10 per cent.). They consisted almost entirely of sand-stars. The following is the list of forms found; *Ophioglypha* in 21; *Amphidotus* in 7; *Amphiura filiformis* and other species in 27; *Echinocyamus* in 2; and *Ophiura albida, Spatangus,* and *Echinocardium,* each in 1. The rest of the echinoderms were unidentified sand-stars.

*Annelids* were found in 485 stomachs (54 per cent.) In the case of 362 stomachs they were not identified. The identified forms found were *Sabella* in 35; *Aphrodite* in 25; *Priapulus,* in 20; sp. *caudatus* in 9; *Nereis* in 11; *Sipunculus* in 10; *Arenicola* in 5; planarians in 5; *Echiurus* in 3.

*Arthropods* were found in 43 stomachs (4 per cent.). The forms found were *Crangon* in 7; *Eupagurus* in 7; *Ampelisca* in 6; *Portunus* in 6; amphipods in 3; *Psamathe* in 3; *Porcellana* sp. *longicornis* in 2; *Pandalus, Hyas* sp. *coarctatus,* each in 1; unidentified hermit-crabs, and unidentified crabs, each in 3.

*Molluscs* were found in 326 stomachs (37 per cent.). The forms found were *Scrobicularia* in 208; *Solen* in 51; *Mactra* sp. subtruncata and ? in 13; *Venus* sp. *lincta, fasciata,* and *falnia* in 8; *Pecten* sp. *tigrinus, striatus* and *opercularia* in 8; *Cardium* sp. *echinatum* and ? in 6; *Nucula* sp. *nitida* and ? in 5; *Psammobia* in 4; *Astarte* sp. *compressa* in 2; *Buccinum* sp. undatum and ? in 2; *Cyprina, Corbula, Leda, Tapes virginica,* each in 1; unidentified lamellibranchs in 22; unidentified gastropods in 1.

*Fish* were found in 46 stomachs (5 per cent.). They consisted of sand-eels in 33; *Lumpenus* in 1; unidentified fish in 12.

*Ascidians* (*Pelonaia*) were found in 5; and an anemone in 1.

From these figures it will be seen that annelids form by far the largest part of the food of plaice in the Firth of Forth. Next to annelids comes *Scrobicularia*. When we pass from these forms we find that the only others forming at all an important proportion are sand-stars and *Solen*. Excluding sand-eels which are found in one locality, fish forms but a small part of the food. All other forms of animals found in the stomachs of plaice, about sixty in number, are unimportant compared with these.

### Lemon Soles.

In all 821 were examined in the Firth of Forth. Of these 488 contained food that could be identified.

*Echinoderms* were found in 12 stomachs (2 per cent.). They consisted of *Holothuria* in 2; *Ophiura albida* in 1; *Ophiothrix rosala* in 1; unidentified sand-stars in 7; unidentified star-fish in 1.

*Annelids* were found in 383 stomachs (78 per cent.). The forms found were *Sabella* in 46; *Sipunculus* in 19; *Priapulus* in 2; *Nereis* and *Lineus bilineatus*, each in 1; unidentified annelids in 314.

*Arthropods* were found in 120 stomachs (24 per cent.). The forms found were *Eupagurus* sp. *bernhardus*, *lævis* and ? in 91; *Porcellana longicornis* in 3; *Portunus corrugatus* in 3; *Atylus* and *Ampelisca*, each in 2; *Galathea*, *Crangon*, *Portunus* sp. ?, *Hyas* and *Cuma*, each in 1; unidentified crustacea in 11; unidentified crabs in 2; unidentified amphipods in 1.

*Molluscs* were found in 33 stomachs (6 per cent.). The forms were *Scrobicularia* in 5; *Natica* in 3; *Chiton* in 2; *Solen*, *Mactra*, *Eolis*, *Mytilus*, and *Trochus*, each in 1; unidentified gastropods in 6; unidentified lamellibranchs in 5; unidentified nudibranchs in 2; unidentified molluscs in 5.

*Fish* were found in only 5 stomachs (1 per cent.)—gobies in 1, and unidentified fish in 4.

*Ascidians*, unidentified, were found in 1; anemones, unidentified, were found in 1, and *Actinoloba* in 1.

From this, it appears that annelids form the chief food of lemon soles. Next to these come hermit-crabs. No other forms approach these in importance, and apart from these the food is very limited indeed.

### Common Dabs.

In all 1211 were examined in the Firth of Forth. Of these 579 contained food that could be identified.

*Echinoderms* were found in 126 stomachs (21 per cent.). The forms were *Ophioglypha* in 38; *Amphiura filiformis* in 23; *Ophiothrix* sp. *rosula* and ? in 15; *Ophiura albida* in 10; *Holothuria* in 3; *Amphiulotus* in 3; unidentified sand-stars in 35.

*Annelids* were found in 94 stomachs (16 per cent.). The forms found were *Sipunculus* in 11; *Sabella* in 6; *Priapulus*, *Aphrodite* and *Polynoe*, each in 3; *Arenicola* in 2; *Tomopteris*, *Terebella* and *Tubularia*, each in 1; unidentified annelids in 63.

*Arthropods* were found in 279 stomachs (48 per cent.) The greater number were hermit-crabs (*Eupagurus bernhardus*, *E. lævis* and others), which were found in 228 stomachs. Other forms of arthropods found, were *Portunus* in 9; *Ampelisca* in 5; *Hyas* in 4 *Porcellana longicornis*

in 3; *Crangon* in 3; *Arcturus* in 2; *Mysis* and *Atylus*, each in 1; unidentified amphipods in 9; unidentified crabs in 4; unidentified crustacea in 9; larval crustacea in 1.

*Molluscs* were found in 115 stomachs (19 per cent.). The forms found were *Pecten* sp. *opercularia* and ? in 33; *Solen* in 24; *Scrobicularia*, sp. *nitida* and ? in 21; *Mytilus* in 4; *Buccinum* in 3; *Modiolaria* and *Cardium*, each in 2; *Philine scabra*, *Venus*, *Montacuta bidentata*, *Corbula gibba* and *Rossia*, each in 1; unidentified gastropods in 3; unidentified lamellibranchs in 2; unidentified nudibranchs in 1; unidentified molluscs in 15.

*Fish* were found in 30 stomachs (5 per cent.). The forms found were sand-eels in 5; herrings in 3; unidentified fish in 22.

*Ascidians* (*Pelonaia* and ?) were found in 3; Cœlenterates were found in 6 stomachs: consisting of *Eudendrium* and *Beroe*, each in 1; anemones in 2; zoophytes in 1; and medusidæ in 1.

The chief food of common dabs in the Firth of Forth is evidently hermit-crabs; no other form of food is so constantly found. Other crustacea are unimportant. Next to hermit-crabs, but to a much less extent, come annelids. After these come sand-stars, clams, *Scrobicularia* and *Solen*. No other organism of the whole series found, with the exception of fish, can be looked upon as forming anything more than a rare article of diet.

### Long Rough Dabs.

In all 1512 were examined on the Firth of Forth. Of these 925 were empty, and 569 contained food that could be identified.

*Echinoderms* were found in 167 stomachs (29 per cent.). The forms were *Ophioglypha* sp. *texturata* and ? in 43; *Ophiocoma* in 20; *Ophiura* sp. *albida* in 18; *Amphiura* in 8; *Ophiothrix* in 7; *Asterias* in 7; *Amphiura* sp. *filiformis* in 4; *Ophiopholis* in 3; unidentified sand-stars in 57.

*Annelids* were found in 52 stomachs (9 per cent.). The forms were *Sipunculus* in 3; *Sabella* in 2; *Echiurus*, *Pectenaria*, and *Sagitta*, each in 1; unidentified annelids in 44.

*Arthropods* were found in 282 stomachs (49 per cent.). The forms were *Crangon* in 126; *Portunus* in 30; *Eupagurus* in 23; *Pandalus* in 21; *Mysis* in 13; *Erythrops* in 9; *Nephrops* and *Ampelisca* each in 3; *Hyas*, *Diastylus*, *Galathea*, and *Cuma*, each in 1; hermit-crabs in 21; unidentified schizopods and amphipods, each in 7; unidentified crabs in 6; unidentified crustacea in 9.

*Molluscs* were found in 38 stomachs (6 per cent.). The forms were *Scrobicularia* in 14; *Solen* in 13; *Pleurotoma* in 2; *Cardium* in 2; *Buccinum*, *Turritella*, *Natica*, *Mactra*, and *Rossia*, each in 1; unidentified lamellibranchs in 2.

*Fish* were found in 84 stomachs (14 per cent.), The forms were gobies in 17; whitings in 5; long rough dabs in 4; sand-eels, pogge, lemon soles, and gurnards each in 2; *Motella*, dragonet and herrings, each in 1; unidentified fish in 47.

It appears that in the Firth of Forth *Crangon* forms by far the most mportant article of food for long rough dabs. Sand-stars, hermit-crabs and fish follow a good way behind these; and other forms are relatively unimportant when compared with these.

### Witch Soles.

In all 217 were examined. Of these 55 were empty, and 150 contained food that could be identified.

*Echinoderms* were found in only 5 stomachs (3 per cent.). The forms were *Amphiura* in 2; unidentified sand-stars in 3.

*Annelids* were found in 109 stomachs (72 per cent.). The forms found were *Sabella* in 14; *Priapulus* in 7; *Nereis* and *Amphiphorus*, each in 1; unidentified annelids in 86.

*Arthropods* were found in 30 stomachs (20 per cent.). The forms were *Ampelisca* in 16; *Crangon* in 10; *Gammarus* and *Eupagurus*, each in 1; unidentified schizopods in 2.

*Molluscs* were found in 21 stomachs (14 per cent.). The forms found were *Scrobicularia* in 12; *Philine* in 6; unidentified molluscs in 3.

*Fish* were found in 2, consisting of gobies in 1; and unidentified fish in 1.

It appears that in the Firth of Forth the chief food of witch soles consists of annelids. Arthropods and molluscs form a small amount and a small variety. Echinoderms and fish are of very little importance.

### Flounders.

Regarding these but little can be said except that from the specimens examined it is impossible to say what forms the chief food. Of 75 examined 72 were empty. Only 2 contained food that could be identified —in one case unidentified annelids, in the other case *Solen*.

### Gurnards.

In all 726 were examined, of which 260 were empty: 453 contained food that could be identified.

*Echinoderms* were found in 2 stomachs (·4 per cent.). They consisted of *Ophiothrix* in one case, and star-fish in the other.

*Annelids* were found in 6 stomachs (1 per cent.). They consisted of *Priapulus* and *Arenicola*, each in 1; and unidentified annelids in 4.

*Arthropods* were found in 426 stomachs (94 per cent.). The forms found were *Crangon* in 153; *Pandalus* in 90; *Portunus* in 88; *Nephrops* in 13; *Eupagurus* in 12; *Mysis* in 4; *Ampelisca* in 4; *Porcellana* and *Erythrops*, each in 3; *Diastylus* in 2; *Corystes* and *Hippolyte*, each in 1; crabs in 5; amphipods in 19; schizopods in 11; cumaceæ in 3; larval decapods in 3; unidentified crustacea in 11.

*Molluscs* were found in 15 stomachs (3 per cent.). The forms found were *Rossia* in 3; *Eolis*, *Loligo*, *Dentalium* and *Patella*, each in 1; unidentified lamellibranchs in 1.

*Fish* were found in 102 stomachs (22 per cent.). They consisted of sand-eels in 9; gobies and herrings, each in 5; pogge in 4; whitings in 3; long rough dabs in 1; post-larval fishes in 1; unidentified fish in 74.

It is clear from these figures that arthropods formed the bulk of the food of gurnards in the Firth of Forth, and that of these the most important were *Crangon*, *Pandalus*, and *Portunus*. Next in importance is fish. Echinoderms, annelids and molluscs formed but a very small part of the food of these fish.

### Cod.

In all 727 were examined, of which 82 were empty: 641 contained food that could be identified.

*Echinoderms* were found in 7 stomachs (1 per cent.). The forms found were *Ophiothrix* in 2; *Ophiocoma* and *Ophioglypha*, each in 1; sand-stars in 3.

*Annelids* were found in 43 stomachs (6 per cent.). The forms were *Aphrodite* in 34; *Arenicola* in 1; unidentified annelids in 8.

*Arthropods* were found in 560 stomachs (87 per cent.). The forms found were *Portunus* in 141; *Crangon* in 117; *Nephrops* in 110; *Eupagurus* in 92; *Pandalus* in 80; *Hyas* in 20; *Galathea* in 12; *Porcellana* in 7; *Balanus* and *Pinnotheres*, each in 2; *Pagurus* and *Nunida*, each in 1; hermit-crabs, unidentified, in 48; unidentified crabs in 18; spider crabs in 7; schizopods in 1; unidentified crustacea in 17.

*Molluscs* were found in 76 stomachs (11 per cent.). The forms found were *Buccinum* in 30; *Pecten* in 13; *Solen* in 12; *Turritella* in 3; *Fusus* in 2; *Rossia* and *Scrobicularia*, each in 1; unidentified lamellibranchs in 12; unidentified cephalopods in 2.

*Fish* were found in 325 stomachs (50 per cent.). The forms found were whitings in 46; sand-eels in 22; long rough dabs in 19; herrings in 17; *Lumpenus* in 11; pogge in 10; sprats in 7; haddocks in 9; codlings in 5; common dabs and cod, each in 4; gobies in 3; *Motella* in 1; gurnards in 1; unidentified fish in 165. A ctenophore was found in 1; and medusids in 1.

It will be seen that arthropods (particularly *Crangon*, *Portunus*, *Nephrops* and *Pandalus*) and fish formed the chief food of cod in the Firth of Forth. Molluscs are but slightly represented. Echinoderms and annelids are relatively unimportant.

## Haddocks.

In all 874 were examined, of which 128 were empty: 703 contained food that could be identified.

*Echinoderms* were found in 208 stomachs (29 per cent.). The forms found were *Amphiura* in 71; *Ophiura* in 51; *Ophioglypha* in 26; *Ophiocoma* 17; *Echinocyamus* in 15; *Ophiothrix* in 14; *Asterias* in 2; *Holothuria* in 1; unidentified sand-stars in 11.

*Annelids* were found in 166 stomachs (23 per cent.). The forms found were *Aphrodite* in 38; *Priapulus* in 11; *Arenicola* and *Sabella*, each in 2; *Nereis*, *Pectenaria*, *Sipunculus*, *Polynoe*, *Echiurus* and a planarian, each in 1; unidentified annelids in 117.

*Arthropods* were found in 422 stomachs (60 per cent.). The forms found were *Crangon* in 105; *Ampelisca* in 65; *Eupagurus* in 42; *Portunus* in 38; *Diastylus* in 18; *Pandalus* and *Nephrops*, each in 8; *Leucon* in 7; *Atylus* in 5; *Hyas* and *Mysis*, each in 2; *Porcellana*, *Galathea*, *Corystes*, and *Urothoe*, each in 1; amphipods in 31; hermit-crabs in 30; cumaceæ in 19; crabs in 3; unidentified crustaceæ in 35.

*Molluscs* were found in 283 stomachs (40 per cent.). The forms found were *Scrobicularia* in 163; *Solen* in 41; *Philine* in 28; *Cylichna* in 7; *Pecten* in 4: *Buccinum* in 3; *Mactra* and *Montacuta*, each in 2; *Rossia*, *Octopus*, *Nucula*, *Actæon*, *Leda*, *Corbula*, *Natica* and *Psammobia*, each in 1; unidentified cephalopods in 2; unidentified lamellibranchs in 22.

*Fish* were found in 40 stomachs (5 per cent.). They consisted of long rough dabs in 2; gobies, sand-eels, herrings and pogge, each in 1; fish ova in 2; unidentified fish in 32.

*Ascidians* were found in 1. *Pleurobrachia* was found in 1; *Actinoloba* in 1; and medusids were found in 3.

The haddock would appear to be one of the most, if not the most, indiscriminate feeder of all the fish examined, its dietary embracing about 70 different species of animals in the Firth of Forth alone. It would appear to eat anything that came its way, and to show no very particular preference for any one kind of food with the exception of *Scrobicularia*, *Crangon* and some annelids.

### Whitings.

In all 1050 were examined, of which 488 were empty: 539 contained food that could be identified.

*Echinoderms* (*Amphiura*) were found in only 1 stomach.

*Annelids* were found in 12 stomachs (2 per cent.). They consisted of *Nereis* in 2; *Aphrodite* in 1; unidentified annelids in 9.

*Arthropods* were found in 201 stomachs (37 per cent.). The forms found were *Crangon* in 107; *Pandalus* in 51; *Eupagurus* in 8; *Portunus* in 6; *Nephrops* in 3; *Porcellana, Atylus, Mysis, Ampelisca, Hyas* and *Stenorhynchus*, each in 1; unidentified schizopods in 6; undentified amphipods in 4; unidentified decapods in 2; crabs in 2; cumaceæ in 2; unidentified crustacea in 5.

*Molluscs* were found in 19 stomachs (3 per cent.). The forms found were *Rossia* in 4; *Mytilus, Octopus* and *Philine*, each in 2; *Scrobicularia* and *Pecten*, each in 1; unidentified cephalopods in 6; unidentified molluscs in 1.

*Fish* were found in 355 stomachs (65 per cent.). The forms were herrings in 29; whitings in 20; sand-eels in 5; gobies in 3; pogge in 2; sprats, long rough dabs, and *Lumpenus*, each in 1; unidentified fish in 293.

*Actinoloba* was found in 1; a ctenophore in 1; and a meduaid in 1.

The whiting seems to have a very constant diet, fish, *Crangon* and *Pandalus* forming the important articles. No other form seems to be at all comparable to these in frequency.

## St Andrews Bay.

### Plaice.

In all 726 were examined, of which 194 were empty: 509 contained food that could be identified.

*Echinoderms* were found in 51 stomachs (10 per cent). The forms found were *Ophioglypha* in 11; *Amphidotus* in 4; *Amphiura* in 3; *Holothuria* in 1; unidentified sand-stars in 32.

*Annelids* were found in 275 stomachs (54 per cent.). The forms found were *Phyllodoce* in 37; *Arenicola* in 32; *Terebella* in 26; *Nereis* and *Sabella*, each in 12; *Aphrodite* in 5; *Lineus bilineatus* in 2; *Spio, Priapulus* and *Pectenaria*, each in 1; unidentified planarians in 2; unidentified annelids in 144.

*Arthropods* were found in 83 stomachs (16 per cent.). The forms found were *Ampelisca* in 45; *Portunus* in 20; *Atylus* in 5; *Diastylus* in 2; *Crangon* and *Phoxus*, each in 1; crabs in 1; amphipods in 5; decapods in 1; unidentified crustacea in 2.

*Molluscs* were found in 301 stomachs (59 per cent.). The forms found were *Solen* in 185; *Nucula* in 79; *Scrobicularia* in 19; *Mactra* in 5; *Venus, Natica, Cylichna, Cardium* and *Montacuta*, each in 1; unidentified lamellibranchs in 8.

*Fish*, unidentified, were found in 1.

These figures show that in St Andrews Bay plaice feed to a very large extent on annelids, *Solen* and *Nucula*. Of less importance are sand-stars, *Ampelisca, Portunus* and *Scrobicularia*. No other forms are at all important.

### Common Dabs.

In all 567 were examined, of which 185 were empty: 356 contained food that could be identified.

*Echinoderms* were found in 153 stomachs (43 per cent.). The forms found were *Ophioglypha* in 50; *Ophiura* in 30; *Amphiura* in 7; *Amphidotus* in 2; *Ophiocoma* in 1; unidentified sand-stars in 63.

*Annelids* were found in 156 stomachs (43 per cent.). The forms found were *Terebella* in 35; *Arenicola* in 24; *Echiurus* in 8; *Phyllodoce* in 3; *Aphrodite* in 2; *Nereis, Micrura* and *Sabella*, each in 1; unidentified planarians in 2; unidentified annelids in 79.

*Arthropods* were found in 81 stomachs (22 per cent.). The forms found were *Portunus* in 43; *Ampelisca* in 14; *Eupagurus* in 7; *Crangon* in 2; crabs in 4; amphipods in 2; unidentified crustacea in 9.

*Molluscs* were found in 64 stomachs (18 per cent.). The forms found were *Solen* in 25; *Scrobicularia* in 4; *Mactra, Pecten, Natica, Mytilus, Nucula*, each in 1; unidentified lamellibranchs in 2; unidentified molluscs in 7.

*Fish* were found in 12 stomachs (3 per cent.). The forms found were gobies, common dabs and herrings, each in 1; unidentified fish in 9.

With the exception of *Portunus* among arthropods and *Solen* among Molluscs, annelids and sand-stars form the chief food of common dabs in St Andrews Bay. *Ampelisca* comes next in order. No other species is of much account.

### Long Rough Dabs.

Of 94 examined, 32 were empty.

With the exception of *Crangon* found in 11, fish found in 5, and annelids found in 2, the food was composed entirely of Echinoderms, viz., ophiurids in 42, and *Ophioglypha* in 7. No molluscs were found in any of the stomachs.

### Gurnards.

In all 407 were examined, of which 130 were empty: 271 contained food that could be identified.

*Echinoderms* (*Ophiura*) were found in only 1.

*Annelids* were found in 9 stomachs. They consisted of *Sabella* in 1; and of unidentified annelids in the others.

*Arthropods* were found in 224 stomachs (82 per cent.). The forms found were *Crangon* in 103; *Portunus* in 76; *Ampelisca* in 14; *Pandalus* in 4; *Eupagurus* in 2; *Corystes* in 1; crabs in 5; schizopods in 2; unidentified crustacea in 17.

*Molluscs* were found in 17 stomachs (6 per cent.). The forms found were *Solen* in 7; *Rossia* in 3; *Loligo, Scrobicularia* and *Natica*, each in 1; unidentified cephalopods in 3; unidentified molluscs in 1.

*Fish* were found in 105 stomachs (38 per cent.). The forms found were whitings in 12; herrings and sand-eels, each in 5; common dabs in 3; long rough dabs in 2; plaice, pipe-fish, cod, sprat and butter-fish, each in 1; post-larval fishes in 3; unidentified fish in 70.

These figures point to the fact that the food of gurnards in St Andrews Bay consists almost exclusively of fish, *Crangon* and *Portunus*, with a small number of other crustacea and a small number of molluscs. Echinoderms count for almost nothing; annelids for very little.

### Haddocks.

In all 132 were examined: 100 of these contained food that could be identified.

*Echinoderms*, chiefly sand-stars, were found in 23 stomachs (23 per cent.).

*Annelids* were fonnd in 43 stomachs (43 per cent.).

*Arthropods* chiefly *Crangon* and *Portunus* were found in 45 stomachs (45 per cent.).

*Molluscs*, *Solen* and *Scrobicularia* being the most numerous, were found in 19 stomachs (19 per cent.).

*Fish* were found in 2.

### Whitings.

In all 137 were examined of which 62 contained food that could be identified. The number is too small to warrant the drawing of any general conclusion, but it may be stated that no *Echinoderms* were found in any of the stomachs; *Molluscs* (cephalopods) were found in only 2; *Annelids* in 13; *Fish* in 36.

The general conclusion from all this is that, once the limit of error is rendered sufficiently small, it is found that nearly every species of fish has a constant dietary, which is usually very limited in character, and that everything eaten beyond this is not staple food but mere occasional picking.

## Year 1891.

## I. FIRTH OF FORTH.

### Plaice.

(*Pleuronectes platessa.*)

Of 327 stomachs examined, 78 were empty.

*Echinoderms* were found in 29 stomachs (19 %). They consisted of (1) *Ophioglypha*, at Station VI., in five in March, in five in May, in two in June, and in two in October: (2) *Amphiura*, at Station IV., in four in September; at Station VII., in one in May, and in four in October; and at Station VIII., in one in October: (3) *Amphidotus*, at Station VIII., in one in April: (4) *Echinocyamus*, at Station VI., in one in March: (5) unidentified starfish, at Station VI., in one in August: (6) unidentified sand-stars, at Station IV., in one in October; and at Station VII., in one in August.

*Annelids* were found in 172 stomachs (69 %). They consisted of (1) *Aphrodite*, at Station II., in fourteen in March, and in one in June; at Station VI., in one in March; at Station VII., in one in May; and at Station VIII., in one in May: (2) *Priapulus*, at Station VII., in one in May, in one in June, and in one in August: (3) *Nereis*, at Station VI., in one in March: (4) *Arenicola*, at Station IV., in one in November. Unidentified planarians were found at Station I., in one in August; and at Station V., in one in May. Unidentified annelids were found in 149 stomachs, viz.—at Station I., in three in March, in four in April, in one in July, in two in August, in four in October, and in one in November; at Station II., in three in April, in three in June, and in three in

November; at Station III., in four in March, in one in April, and in nine in May; at Station IV., in five in March, in ten in May, in four in June, in six in August, and in six in October; at Station V., in one in March, in five in May, in one in June, in three in July, in five in August, in two in October, in five in November, and in four in December; at Station VI., in six in March, in four in May, in one in August, and in two in October; at Station VII., in two in June, in five in August, in three in October, and in three in November; at Station VIII., in four in May, in five in July, in four in August, and in one in November; and at Station IX., in two in May, in two in September, in five in October, and in one in November.

*Arthropods* were found in 10 stomachs (4 %). They consisted of (1) *Ampelisca*, at Station VI., in one in May; at Station VII., in one in June, and in one in August; and at Station VIII., in one in July: (2) *Portunus*, at Station IV., in one in March; and at Station V., in one in March: (3) *Eupagurus*, at Station VI., in one in May, and in one in October: (4) *Pandalus*, at Station III., in one in May: (5) *Porcellana* (sp. *longicornis*), at Station III., in one in May.

*Molluscs* were found in 87 stomachs (34 %). They consisted of (1) *Scrobicularia*, found in 65 stomachs, viz.—at Station I., in three in March, in two in April, in two in July, and in four in August; at Station II., in fourteen in March, in two in April, in five in May, in four in August, in two in October, and in two in November; at Station III., in three in April; at Station V., in seven in May, in five in June, in two in July, in two in August, in three in October, and in one in December; and at Station VI., in one in March, and in two in October: (2) *Solen*, at Station I., in one in July, and in one in November; at Station II., in one in June, and in two in October; at Station IV., in three in May, and in one in November; and at Station VI., in one in August: (3) *Psammobia*, at Station VI., in two in March, and in one in October: (4) *Mactra* (sp. *subtruncata*), at Station VI., in one in March; and at Station VII., in one in May: (5) *Pecten* (sp. *opercularis*), at Station III., in one in March: (6) *Astarte* (sp. *compressa*), at Station VI., in one in May: (7) *Leda*, at Station I., in one in July: (8) *Nucula*, at Station V., in one in August: (9) *Venus*, at Station VI., in one in August: (10) unidentified lamellibranchs, at Station VI., in one in October: (11) unidentified gastropods, at Station VII., in one in August.

*Ascidians* (*Pelonaia*) were found in 4 stomachs, viz.—at Station VII., in two in June; and at Station VIII., in two in May.

*Fish* were found in 16 stomachs (6 %). They consisted of (1) sand-eels, at Station VI., in four in March, in two in May, in four in June, in four in August, and in one in November.

## Lemon Soles.

(*Pleuronectes microcephalus.*)

Of 206 stomachs examined, 67 were empty.

No *Echinoderms* were found in any of the stomachs.

*Annelids* were found in 124 stomachs (89 %). They consisted of (1) *Sabella*, at Station I., in one in March; at Station V., in one in March; at Station VI., in two in May; and at Station IX., in one in July: (2) unidentified annelids in 119 stomachs, viz.—at Station I., in three in March, in four in April, in three in May, in five in August, in one in October, and in one in November; at Station II., in five in March, in

four in April, in one in May, in two in June, in three in August, and in two in October; at Station III., in nine in March, in two in May, in one in September, in four in October, and in one in November; at Station IV., in three in March, in two in May, in five in July, and in four in August; at Station V., in three in March, in eight in May, in four in June, in four in July, and in two in October; at Station VI., in three in March, in three in May, in one in June, in seven in August, and in two in October; at Station VII., in four in May, in two in June, and in two in August; at Station VIII., in two in April, and in one in July; and at Station IX., in three in May, in two in July, and in one in October.

*Arthropods* were found in 21 stomachs (15 %). They consisted of (1) *Eupagurus*, at Station I., in one in March, in one in April, in one in May, and in one in October; at Station II., in three in March, in one in May, and in one in June; at Station V., in two in May, in one in June, and in one in July; at Station VI., in one in March; and at Station IX., in one in May: (2) *Ampelisca*, at Station V., in two in March: (3) *Hyas*, at Station III., in one in May: (4) *Cuma*, at Station VIII., in one in April: (5) *Atylus* (sp. *bispinosus*), at Station V., in one in October.

*Molluscs* were found in 7 stomachs (5 %). They consisted of (1) *Scrobicularia*, at Station I., in three in July: (2) *Mytilus*, at Station VI., in one in March: (3) *Trochus*, at Station II., in one in June: (4) *Chiton*, at Station VIII., in one in April: (5) unidentified nudibranchs, at Station V., in one in October.

## Common Dabs.

(*Pleuronectes limanda.*)

Of 324 stomachs examined, 206 were empty, and the contents of 1 were indistinguishable: 117 contained matter that could be identified.

*Echinoderms* were found in 31 stomachs (26 %). They consisted of (1) *Ophioglypha*, at Station II., in three in November; at Station V., in one in March; at Station VI., in five in March, in two in May, in two in August, and in one in October; at Station VII., in one in May, in one in June, and in one in October; at Station VIII., in one in August; and at Station IX., in one in August: (2) *Ophiothrix* (sp. *rosula* and ?), at Station II., in one in March, and in one in June; and at IX., in three in October: (3) *Amphiura*, at Station V., in one in July; and at Station VII., in two in September: (4) unidentified ophiurids, at Station VII., in four in August.

*Annelids* were found in 14 stomachs (11 %). They consisted of (1) *Aphrodite*, at Station II., in one in June; and at Station IX., in one in October: (2) *Sipunculus*, at Station II., in one in August: (3) unidentified annelids, at Station I., in one in August; at Station II., in two in April; at Station IV., in one in July; at Station V., in one in May; at Station VI., in one in December; at Station VII., in one in October; and at Station IX., in one in May, in two in August, and in one in September.

*Arthropods* were found in 48 stomachs (41 %). They consisted of (1) *Eupagurus* (sp. *bernhardus* and *lævis*), at Station I., in two in March, in two in May, in one in July, in two in August, in one in October, and in two in November; at Station II., in two in March, in one in April, in one in May, and in one in November; at Station III., in three in March, in one in May, in two in August, and in two in October; at Station IV., in one in May; at Station V., in one in May, in one in June, in two in July, in one in August, and in one in October; at Station VI., in one in

August; at Station VII., in one in May, and in one in June; at Station VIII., in one in July, and in one in August; and at Station IX., in one in May: (2) *Portunus*, at Station IV., in two in August; and at Station VIII., in one in May: (3) *Porcellana* (sp. *longicornis*), at Station I., in one in August; and at Station IX., in one in August: (4) *Ampelisca*, at Station VI., in one in May: (5) *Hyas* (sp. *coarctatus*), at Station II., in one in June: (6) *Arcturus*, at Station VIII., in one in July: (7) *Crangon*, at Station VI., in one in November: (8) unidentified crustacea, at Station III., in one in May; and at Station IX., in one in September.

*Molluscs* were found in 22 stomachs (18 %). They consisted of (1) *Pecten*, at Station I., in three in April, and in one in July; at Station III., in five in March, in two in October, and in one in November; and at Station IV., in four in March: (2) *Mytilus*, at Station VI., in one in March, and in one in October: (3) *Cardium*, at Station I., in one in March: (4) *Solen*, at Station VII., in one in May: (5) unidentified gastropods, at Station VII., in one in August.

*Fish* were found in 4 stomachs (3 %). They consisted of (1) sand-eels, at Station VIII., in one in April: (2) unidentified fish, at Station IV., in one in May; at Station V., in one in November; and at Station VI., in one in August.

*Zoophytes* (sp. ?) were found at Station II., in one in May.

## Long Rough Dabs.

(*Hippoglossoides limandoides*.)

Of 304 stomachs examined, 208 were empty.

*Echinoderms* were found in 23 stomachs (24 %). They consisted of (1) *Ophioglypha*, at Station II., in one in March, in one in April, in two in June, in two in July, and in three in August; at Station III., in one in May; at Station V., in one in June; at Station VII., in one in May, in one in June, in three in August, and in one in October; and at Station VIII., in one in August: (2) *Ophiothrix*, at Station II., in one in March, in one in October, and in two in November: (3) unidentified starfish, at Station IV., in one in May.

*Annelids* were found in 9 stomachs (9 %). They were all unidentified and were found at Station III., in one in December; at Station V., in one in June, and in one in December; at Station VII., in two in June, and in one in September; at Station VIII., in one in August; and at Station IX., in one in May, and in one in July.

*Arthropods* were found in 46 stomachs (47 %). They consisted of (1) *Crangon*, at Station I., in one in August, and in three in October; at Station II., in two in November; at Station V., in one in June, in one in October, and in one in November; at Station VI., in one in December; at Station VII., in one in October, and in one in November; at Station VIII., in one in October; and at Station IX., in one in September: (2) *Portunus*, at Station III., in one in March; at Station VI., in one in May; at Station VIII., in seven in September; and at Station IX., in one in September: (3) *Mysis* (sp. *ornatus* and ?), at Station V., in one in May, in one in June, and in one in October; at Station VIII., in two in May; and at Station IX., in one in April, in one in May, and in one in August: (4) *Eupagurus*, at Station III., in one in August; at Station V., in one in March, in one in June, and in one in November; and at Station VIII., in one in August: (5) *Erythrops*, at Station V., in one in June; and at Station VIII., in two in May: (6) *Pandalus*, at Station VII., in

one in September; and at Station IX., in one in September: (7) *Galathea*, at Station I., in one in April: (8) *Nephrops*, at Station V., in one in July: (9) unidentified amphipods, at Station V., in one in July: (10) unidentified cumaceæ at Station V., in one in July.

*Molluscs* were found in 5 stomachs (5 %). They consisted of (1) *Solen*, at Station V., in one in June, in one in July, and in one in August: (2) *Scrobicularia*, at Station I., in one in May; and at Station V., in one in May.

*Fish* were found in 25 stomachs (26 %). They consisted of (1) gobies, at Station III., in one in March; at Station IV., in two in July, in two in October, and in one in November; at Station V., in one in March; and at Station VII., in one in June, and in one in August: (2) whitings, at Station IX., in one in August: (3) dabs, at Station IV., in one in May: (4) unidentified fish remains, at Station I., in one in March; at Station II., in one in March; at Station III., in one in October; at Station IV., in one in July; at Station V., in two in October, in one in November, and in two in December; and at Station IX., in two in May, in one in August, in one in September, and in one in November.

## Witch Soles.

(*Pleuronectes cynoglossus.*)

Of 50 stomachs examined, 8 were empty.

*Echinoderms* (*Amphiura*) were found at Station VII., in one in June.

*Annelids* were found in 40 stomachs (95 %). They consisted of *Priapulus*, at Station V., in one in May; and at Station VII., in one in June, and in one in October: (2) *Sabella*, at Station V., in one in August; and at Station IX., in one in August: (3) unidentified annelids, at Station V., in three in March, in five in May, in one in June, in one in July, and in one in October; at Station VII., in one in March, in one in June, and in one in October; at Station VIII., in one in April, in four in May, in four in July, and in one in October; and at Station IX., in three in April, in two in July, and in four in October.

*Arthropods* were found in 11 stomachs (26 %). They consisted of (1) *Ampelisca*, at Station V., in one in March; at Station VII., in one in June; at Station VIII., in one in May, in one in July, and in one in October; and at Station IX., in one in April, and in one in October: (2) *Crangon*, at Station VIII., in one in October; and at Station IX., in three in October.

*Molluscs* were found in 6 stomachs (14 %). They consisted of (1) *Scrobicularia*, at Station V., in two in May, and in two in June: (2) *Philine*, at Station V., in one in March; at Station VII., in one in March; and at Station IX., in one in October.

*Fish* (gobies) were found at Station VIII., in one in July.

## Flounders.

(*Pleuronectes flesus.*)

Of 23 stomachs examined, 31 were empty. *Annelids* (unidentified) were found in the remaining one at Station I. in March.

### GURNARDS.

(*Trigla gurnardus.*)

Of 198 stomachs examined, 80 were empty.

*Echinoderms* (unidentified starfish) were found at Station II., in one in August.

*Annelids* (*Arenicola*) were found at Station VIII., in one in July.

*Arthropods* were found in 100 stomachs (84 %). They consisted of (1) *Crangon*, at Station I., in two in August; at Station III., in one in August; at Station IV., in one in November; at Station V., in seven in May, and in one in October; at Station VI., in one in May, in four in October, and in two in November; at Station VII., in one in May; at Station VIII., in one in April, in one in August, and in three in October; and at Station IX., in three in May, in three in July, in three in August, and in three in October: (2) *Portunus*, at Station I., in one in July, and in one in August; at Station II., in one in June, and in two in August; at Station III., in one in August; at Station IV., in two in May, in two in July, and in three in August; at Station VI., in three in August; at Station VII., in one in May, in one in June, in two in August, and in one in October; at Station VIII., in one in May; and at Station IX., in one in September: (3) *Pandalus*, at Station I., in one in August; at Station II., in two in May, and in one in October; at Station IV., in one in August, and in one in November; at Station V., in two in May, and in one in August; at Station VI., in three in May, and in one in October; at Station VII., in one in May; at Station VIII., in two in April, and in one in August; and at Station IX., in three in April, and in one in August: (4) *Nephrops*, at Station I., in one in August; at Station III., in one in October; at Station V., in three in July, in one in August, and in two in October; and at Station VIII., in one in July: (5) *Mysis*, at Station VI., in one in May; and at Station IX., in two in August: (6) *Hippolyte*, at Station VIII., in one in August: (7) *Eupagurus*, at Station III., in one in October: (8) unidentified crustacea, at Station I., in one in July, and in two in October; at Station IV., in one in August; and at Station V., in one in June.

*Molluscs* were found in 7 stomachs (6 %). They consisted of (1) *Patella*, at Station VI., in one in October: (2) unidentified cephalopods, at Station II., in one in August; at Station V., in one in May, and in one in July; and at Station VIII., in one in May, and in two in October.

*Fish* were found in 32 stomachs (27 %). They consisted of (1) gobies, at Station V., in one in October; at Station VI., in two in October; and at Station VII., in two in June: (2) sand-eels, at Station VI., in four in May: pogge, at Station IV., in two in August; and at Station VI., in one in March: (3) whitings, at Station VI., in one in August: (4) unidentified fish remains, at Station II., in one in May, in one in June, and in one in November; at Station V., in one in June, and in one in October; at Station VI., in one in August, and in two in October; at Station VII., in one in May; at Station VIII., in one in July, and in three in October; and at Station IX., in one in May, in one in August, and in three in October: (5) post-larval fishes, at Station V., in one in October.

### COD.

(*Gadus morrhua.*)

Of 131 stomachs examined 19 were empty.

No *Echinoderms* were found in any of the stomachs.

*Annelids* were found in 5 stomachs (4%). They consisted of (1) *Aphrodite*, at Station V., in one in March, and in one in October; and at Station VII., in one in September: (2) *Arenicola*, at Station IV., in one in March: (3) unidentified annelids, at Station VIII., in one in April.

*Arthropods* were found in nearly every stomach. They consisted of (1) *Portunus*, at Station I., in one in August, in three in October, and in two in November; at Station II., in one in November; at Station III., in two in March, in two in May, in three in September, and in five in October; at Station IV., in one in March, and in one in May; at Station V., in two in July; at Station VI., in one in October, and in one in November; at Station VII., in one in March, and in one in May; and at Station VIII., in one in August: (2) *Nephrops*, at Station I., in one in March, in one in April, and in one in May; at Station V., in three in March, in four in May, in two in June, and in five in October; at Station VII., in one in May; at Station VIII., in one in September; and at Station IX., in one in July, in one in August, and in one in September: (3) *Eupagurus*, at Station I., in one in April; at Station II., in one in April; at Station III., in one in March, in one in May, in one in September, in three in October, and in one in December; at Station IV., in three in March; at Station V., in one in July, and in one in October; at Station VI., in one in August, and in one in November; at Station VII., in one in March, and in one in September; at Station VIII., in one in April, and in one in August; and at Station IX., in one in September: (4) *Pandalus*, at Station I., in one in April, in one in August, and in three in November; at Station II., in one in March, and in one in April; at Station III., in one in March, in two in May, in one in September, and in one in December; at Station V., in two in March, and in one in May; and at Station VII., in one in May, and in two in September: (5) *Crangon*, at Station I., in one in October, and in one in November; at Station III., in one in October; at Station IV., in one in March; at Station V., in three in March, in one in October, and in one in November; and at Station IX., in one in September, and in one in October: (6) *Hyas*, at Station I., in one in April; at Station VI., in one in May; at Station VII., in one in March; and at Station VIII., in one in April: (7) *Porcellana*, at Station III., in one in May: (8) *Galathea*, at Station V., in one in July: (9) unidentified crustacea, at Station VI., in one in October.

*Molluscs* were found in 16 stomachs (14%). They consisted of (1) *Buccinum*, at Station I., in one in March; at Station III., in one in May, and in one in September; and at Station V., in one in March, and in two in July: (2) *Pecten*, at Station I., in one in November; at Station III., in two in March; and at Station IV., in two in March: (3) *Solen*, at Station VI., in two in October; and at Station VII., in one in September: (4) unidentified cephalopods, at Station III., in one in December; and at Station VI., in one in May.

*Fish* were found in 60 stomachs (53%). They consisted of (1) sand-eels, at Station VI., in six in May, and in two in October: (2) pogge, at Station III., in one in May, and in one in September; at Station IV., in one in March; at Station VI., in one in October; at Station VII., in one in March; and at Station VIII., in one in August: (3) *Lumpenus*, at Station I., in one in August; at Station V., in one in May, and in one in June; and at Station IX., in one in April, and in two in July: (4) whitings, at Station III., in one in October; and at Station IV., in one in March, and in one in November: (5) gobies, at Station III., in one in September; and at Station VII., in two in September: (5) haddocks, at Station III., in one in December; and at Station IX., in one in July;

(6) herrings, at Station I., in one in March; and at Station IV., in one in November: (7) cod, at Station III., in one in March: (8) gurnards, at Station IX., in one in July: (9) long rough dabs, at Station IX., in one in July: (10) common dabs, at Station IV., in one in November: (11) unidentified fish remains, at Station I., in one in March, in two in October, and in one in November; at Station II., in one in April; at Station III., in one in October, and in four in November; at Station IV., in two in March, and in one in November; at Station V., in four in March, in three in May, in one in July, and in one in December; at Station VI., in two in August, and in one in November; and at Station VIII., in one in September.

### Haddocks.

(*Gadus æglefinus.*)

Of 183 stomachs examined, 35 were empty.

*Echinoderms* were found in 48 stomachs (32%). They consisted of (1) *Amphiura*, at Station V., in one in October; at Station VII., in four in March, in four in May, in five in June, in five in August, in six in September, in two in October, and in one in November; and at Station IX., in two in May: (2) *Ophioglypha*, at Station II., in one in May, and two in October; at Station V., in one in March; at Station VI., in four in October; at Station VII., in one in May, and in one in November; and at Station VIII., in one in May, and in one in November: (3) *Ophiothrix*, at Station I., in one in July, and in two in August: (4) unidentified starfish, at Station I., in one in July; and at Station VIII., in two in August: (4) *Echinocyamus*, at Station VI., in one in October.

*Annelids* were found in 41 stomachs (27%). They consisted of (1) *Aphrodite*, at Station I, in one in April, and in one in August; at Station II., in two in June; at Station V., in one in May; at Station VII., in one in March, and in one in May; and Station VIII., in one in July; and at Station IX., in two in May: (2) *Priapulus*, at Station II., in one in June; and at Station V., in one in March: (3) *Arenicola*, at Station VIII., in one in July. A planarian (sp. ?) was found at Station V., in one in May: (4) unidentified annelids were found in 27 stomachs, viz.—at Station I., in one in July; at Station V., in one in May, in one in June, in two in August, and in two in October; at Station VII., in two in March, in two in June, and in one in September; at Station VIII., in one in April, in one in July, in five in August, and in two September; and at Station IX., in five in April, and in one in July.

*Arthropods* were found in 84 stomachs (56%). They consisted of (1) *Ampelisca*, at Station I., in two in May; at Station III., in two in November; at Station V., in two in May, in one in June, in two in July, in one in August, and in one in November; at Station VII., in one in March, in two in May, and in one in September; at Station VIII., in one in July; and at Station IX., in one in July: (2) *Crangon*, at Station I., in one in March; at Station III., in three in November; at Station V., in one in November; at Station VII., in two in March, in one in May, in one in September, and in two in October; and at Station VIII., in one in October, and in one in November: (3) *Eupagurus*, at Station I., in one in April., and in one in May; at Station II., in one in June, in one in August, and in one in October; at Station III., in one in May; at Station V., in one in March; at Station VII., in one in March; and at Station VIII., in one in April, and in one in November:

(4) *Diastylis*, at Station VIII., in four in April; and at Station IX., in five in April: (5) *Portunus*, at Station II., in one in June, and in one in October; at Station V., in one in October; at Station VII., in one in September, and in two in October; and at Station VIII., in one in July, and in one November: (6) *Leucon*, at Station VIII., in three in April; and at Station IX., in one in April: (7) *Nephrops*, at Station V., in one in August; and at Station VIII., in one in September: (8) *Mysis*, at Station VIII., in one in November: (9) *Hyas*, at Station III., in one in May: (10) unidentified cumaceæ, at Station I., in four in May; and at Station IX., in three in July: (11) unidentified amphipods, at Station VIII., in four in May; and at Station IX., in one in April: (12) unidentified crustacea, at Station VIII., in one in October; and at Station IX., in one in May.

*Molluscs* were found in 55 stomachs (37%). They consisted of (1) *Scrobicularia*, at Station I., in one in April, and in two in July; at Station II., in one in May; at Station V., in one in March, in seven in May, in five in June, in five in July, and in five in August; and in one in October; at Station VIII., in one in April; and at Station IX., in one in April: (2) *Solen*, at Station I., in one in April; at Station II., in two in May, and in four in June; at Station V., in two in March, and in one in October; at Station VII., in one in May, and in one in October; at Station VIII., in one in November; and at Station IX., in one in May: (3) *Philine*, at Station I., in one in April; and at Station VII., in one in March, in two in October, and in one in November: (4) *Cylichna*, at Station V., in one in July; and at Station IX., in one in April: (5) *Psammobia*, at Station I., in one in March: (6) *Mactra*, at Station III., in one in May: (7) *Pecten*, at Station I., in one in August: (8) unidentified cephalopods, at Station II., in one in August; and at Station VI., in one in December.

*Fish* were found in two stomachs,—pogge, at Station VII., in one in March: and unidentified fish remains, at Station VIII., in one in November.

## WHITINGS.

(*Gadus merlangus.*)

Of 235 stomachs examined, 108 were empty.

*Annelids* were found in 2 stomachs,—*Aphrodite*, at Station VII., in one in March: and unidentified annelids, at Station VIII., in one in August.

*Arthropods* were found in 61 stomachs (48%). They consisted of (1) *Crangon*, at Station I., in two in April, in one in May, and in two in November; at Station II., in one in November; at Station III., in two in March, in one in October, and in two in December; at Station V., in one in May, in two in June, in four in November, and in two in December; at Station VI., in one in May; at Station VII., in one in March; at Station VIII., in one in April, in three in September, and in two in November; and at Station IX., in one in April, and in five in November: (2) *Pandalus*, at Station I., in two in April, and in one in November; at Station III., in one in March, in one in May, in two in September, and in three in November; at Station IV., in one in August; at Station V., in one in July, and in one in October; at Station VI., in two in May; at Station VII., in four in September; at Station VIII., in one in April; and at Station IX., in one in April: (3) *Eupagurus*, at Station IV., in two in August: (4) *Nephrops*, at Station II., in one in August; and at Station V., in one in December: (5) *Ampelisca*, at

Station VII., in one in March; (6) *Portunus*, at Station I., in one in May: (7) *Hyas*, at Station VI., in one in May: (8) *Stenorhynchus*, at Station I., in one in August: (9) unidentified amphipods, at Station VIII., in one in May.

*Molluscs* were found in 6 stomachs (4%). They consisted of (1) *Mytilus*, at Station VI., in one in March; (2) unidentified cephalopods, at Station V., in one in November, and in two in December; at Station VI., in one in May; and at Station VIII., in one in November.

*Fish* were found in 76 stomachs (59%). They consisted of (1) sand-eels, at Station VI., in one in March, in one in May, and in one in June: (2) herrings or sprats, at Station I., in one in March; at Station II., in one in June; and at Station IX., in one in May: (3) whitings, at Station V., in one in June: (4) pogge, at Station III., in one in September: (5) unidentified fish remains, at Station I., in two in March, in one in April, in two in May, in one in June, in three in October, and in one in November; at Station II., in one in June, in two in October, and in three in November; at Station III., in two in March, in one in August, in two in September, in three in October, in two in November, and in three in December; at Station IV., in one in October, and in one in November; at Station V., in one in May, in three in October, and in three in November; at Station VI., in one in May, and in three in October; at Station VII., in three in March, in two in June, in two in September, in five in October, and in one in November; at Station VIII., in two in April, in one in July, in three in September, in one in October, and in one in November; and at Station IX., in one in April, in two in May, and in two in November.

A *Medusid* (sp. ?) was found at Station III., in one in August.

## SKATE.

(*Raia batis, R. clavata, and R. radiata.*)

Of 62 stomachs examined, 29 were empty.

Unidentified *Annelids* were found at Station VIII., in one in November; and at Station IX., in one in April.

*Arthropods* were found in almost all the stomachs. They consisted of (1) *Portunus* (sp. *depurator, holsatus*, and ?), at Station I., in one in April; at Station II., in one in May, and in one in August; at Station III., in one in March, in two in October, in two in November, and in one in December; at Station IV., in one in May, in one in July, and in one in August; at Station VII., in four in September; and at Station VIII., in one in July: (2) *Crangon*, at Station I., in one in April; at Station III., in one in October, and in two in December; at Station IV., in one in March; at Station VII., in two in September; and at Station VIII., in two in October: (3) *Pandalus*, at Station III., in one in October, and in one in December; at Station IV., in one in May; at Station VII., in two in September; and at Station IX., in one in August: (4) *Eupagurus*, at Station II., in one in October; at Station IV., in one in August; and at Station IX., in one in August: (5) *Nephrops*, at Station I., in one in April; and at Station IX., in one in November: (6) *Hyas*, at Station II., in one in May: (7) unidentified crustacea, at Station III., in one in May

Unidentified *fish remains* were found at Station IV., in one in March; at Station VIII., in one in October; and at Station IX., in one in October.

### Cat-Fish.

(*Anarrhichas lupus.*)

Of 12 stomachs examined, 2 were empty.

*Echinoderms* (*Ophiothrix*) were found in 4 stomachs (40%),—at Station I., in one in April, in one in May, and in one in August; and at Station II., in one in April.

*Arthropods* were found in 3 stomachs (30%). They consisted of (1) *Nephrops*, at Station V., in one in March: (2) *Hyas*, at Station III., in one in March: (3) *Eupagurus*, at Station I., in one in May.

*Molluscs* were found in 7 stomachs (70%). They consisted of (1) *Pecten*, at Station I., in three in April; and at Station V., in one in March: (2) *Buccinum*, at Station I., in one in April, and in one in August; and at Station III., in one in March.

*Fish* (herrings) were found at Station IV., in one in July: and unidentified fish remains at Station IV., in one in July.

### Angler Fish.

(*Lophius piscatorius.*)

Of 27 stomachs examined, 14 were empty.

*Arthropods* (*Nephrops*) were found at Station IX., in one in September.

*Molluscs* (unidentified cephalopods) were found at Station III., in one in December; and at Station IX., in one in November.

Unidentified *fish remains* were found in 9 stomachs.

## II. ST ANDREWS BAY.

### Plaice.

(*Pleuronectes platessa.*)

Of 119 stomachs examined, 43 were empty.

*Echinoderms* were found in 11 stomachs (14%). They consisted of (1) *Ophioglypha*, at Station I., in one in August, and in one in November; at Station II., in one in November; at Station III., in two in July, and in one in November; at Station IV., in two in July; and at Station V., in one in October: (2) *Amphidotus* (sp. *cordatus*), at Station V., in one in July: (3) *Amphiura*, at Station III., in one in August.

*Annelids* were found in 23 stomachs (30%). They consisted of (1) *Arenicola*, at Station I., in one in July, and in one in November; and at Station II., in one in July: (2) planarians, at Station V., in one in July: (3) unidentified annelids, at Station I., in one in August, and in two in November; at Station III., in three in August; at Station IV., in five in July, in two in August, and in two in November; and at Station V., in two in July, and in two in October.

*Arthropods* (*Portunus*) were found at Station II., in one in November.

*Molluscs* were found in 55 stomachs (72%). They consisted of (1) *Solen*, at Station I., in three in July, in three in August, in two in October, and in two in November; at Station II., in four in July, in three in October, and in one in November; at Station III., in six in July, and in two in November; at Station IV., in five in July, and in two in November; and at Station V., in six in July, in one in August, in one in October, and in one in November: (2) *Nucula* (sp. *nitida*), at Station II., in one in October; at Station III., in one in July; and at Station V., in two in July, in six in October, and in one in November.

### Common Dabs.

(*Pleuronectes limanda.*)

Of 119 stomachs examined, 48 were empty.

*Echinoderms* were found in 34 stomachs (47%). They consisted of (1) *Ophioglypha*, at Station I., in six in July, in five in August, in two in October, and in two in November; at Station II., in four in October, and in two in November; at Station III., in four in July, in one in August, and in one in November; at Station IV., in one in July, in one in August, and in one in November; and at Station V., in one in August, and in two in November: (2) *Amphiura*, at Station III., in one in August.

*Annelids* were found in 28 stomachs (39%). They consisted of (1) *Arenicola*, at Station I., in two in July, in two in October, and in three in November; and at Station III., in one in November: (2) *Echiurus*, at Station III., in one in July: (3) a planarian, at Station III., in one in July: (4) unidentified annelids, at Station I., in two in July, and in one in November; at Station III., in two in July, in two in August, and in two in November; at Station IV., in five in July, in one in August, and in two in November; and at Station V., in one in July.

*Arthropods* were found in 8 stomachs (11%). They consisted of (1) *Eupagurus*, at Station V., in one in July, and in two in August: (2) *Portunus*, at Station III., in one in December; and at Station V., in one in October: (3) unidentified crustacea, at Station V., in three in July.

*Molluscs* were found in 3 stomachs (4%). They consisted of (1) *Solen*, at Station IV., in one in November; and at Station V., in one in July: (2) *Nucula* (sp. *nitida*), at Station V., in one in July.

*Fish remains* (herring or sprat) were found at Station III., in one in July.

### Long Rough Dabs.

(*Hippoglossoides limandoides.*)

Of 10 stomachs examined, 6 were empty.

*Echinoderms* (*Ophioglypha*) were found at Station I., in one in July, and in one in November; at Station III., in one in July; and at Station V., in one in July.

*Fish remains* were found at Station I., in one in November.

### Gurnards.

(*Trigla gurnardus.*)

Of 115 stomachs examined, 48 were empty.

Unidentified *Annelids* were found in 4 stomachs,—at Station I., in one in July, and in three in August.

*Arthropods* were found in 39 stomachs (58%). They consisted of (1) *Crangon*, at Station I., in two in October, and in one in November; at Station II., in three in October, and in four in November; at Station III., in two in November; at Station IV., in one in July, and in one in November; and at Station V., in three in November: (2) *Portunus*, at Station I., in three in July, and in one in October; at Station II., in four in July, in one in August, and in two in November; at Station IV., in two in July, in one in August, and in one in November; and at Station V., in one in July: (3) *Eupagurus*, at Station III., in one in July: (4) *Pandalus*, at Station I., in one in October: (5) *Ampelisca*, at Station V., in one in October: (6) unidentified crustacea, at Station II., in one in August; and at Station V., in two in July.

*Molluscs* were found in 5 stomachs (7%). They consisted of (1) *Solen*, at Station IV., in one in July: (2) *Natica* (sp. *alderi*), at Station

V., in one in August: (3) unidentified cephalopods, at Station II., in one in November; at Station III., in one in July; and at Station V., in one in August.

*Fish* were found in 33 stomachs (49%). They consisted of (1) sand-eels at Station IV., in four in July: (2) cod, at Station II., in one in August: (3) sprats, at Station III., in one in August: (4) butter-fish, at Station I., in one in November: (5) whitings, at Station III., in one in November: (6) post-larval fishes, at Station V., in three in October: (7) unidentified fish remains, at Station I., in one in July, in three in October, and in two in November; at Station II., in three in October, and in two in November; at Station III., in one in August, and in one in November; at Station IV., in two in November; and at Station V., in two in July, in two in August, and in three in November.

### Haddocks.

(*Gadus æglefinus.*)

Of 9 stomachs examined, 1 was empty.

*Echinoderms* (*Ophioglypha*) were found at Station II., in one in October.

*Annelids* were found in 2 stomachs,—*Priapulus*, at Station V., in one in November; and unidentified annelids, at Station III., in one in July.

*Arthropods* were found in 5 stomachs. They consisted of (1) *Crangon*, at Station IV., in two in November; and at Station V., in one in October: (2) *Portunus*, at Station II., in one in October: (3) unidentified crustacea, at Station V., in one in October.

*Fish remains* were found at Station IV., in one in November; and at Station V., in one in November.

### Whitings.

(*Gadus merlangus.*)

Of 25 stomachs examined, 14 were empty.

*Annelids* (*Arenicola*) were found at Station V., in one in July.

*Arthropods* (*Crangon*) were found at Station III., in one in November.

*Fish* were found in 9 stomachs. They consisted of (1) whitings, at Station IV., in four in November: (2) herrings, at Station I., in one in October, and in one in November: (3) sand-eels, at Station V., in one in July: (4) unidentified fish remains, at Station II., in one in July; and at Station V., in one in November.

### Less Abundant Fish of St Andrews Bay.

*Flounders* (*Pleuronectes flesus*).—Seven were examined: all were empty.

*Skate* (*Raia batis*, *R. clavata*, and *R. radiata*).—Of 17 stomachs examined, 5 were empty. *Annelids* were found in 2 stomachs:—*Nereis* at Station I., in one in July: and unidentified annelids, at Station I., in one in November; and at Station II., in one in November. *Arthropods* were found in 10 stomachs:—*Crangon*, at Station III., in one in November; and at Station IV., in two in November: *Portunus*, at Station I., in one in July; and at Station IV., in one in July: *Corystes*, at Station IV., in two in July: *Eupagurus*, at Station III., in one in November: *Pandalus*, at Station IV., in one in November. Molluscs were found in 2 stomachs:—*Buccinum*, at Station IV., in one in July: *Solen*, at Station IV., in one in November. Unidentified *fish remains* were found at Station II., in one in November; at Station III., in one in November; and at Station IV., in one in November.

*Cod* (*Gadus morrhua*).—One examined at Station IV. in November contained *Eupagurus*.

## II.—OBSERVATIONS ON THE REPRODUCTION, MATURITY, AND SEXUAL RELATIONS OF THE FOOD FISHES. By Dr T. Wemyss Fulton, F.R.S.E., Secretary for Scientific Investigations (Plate VI.).

In previous reports were published certain of the results of inquiries on the spawning, maturity, and sexual relations of the food fishes * carried out under the scheme of investigation which I devised in the spring of 1888. This system was first put into execution in the summer of that year, and has been continued since; and thus a mass of material exists, which during the past few months I have studied anew. Pressure of space and time will prevent anything but a bare statement of the facts; and the same circumstance debars me at present from comparing the results as carefully as is desirable with those obtained by Mr W. E. Holt on the West Coast of Ireland.† I may add that all the statements made in this paper, unless expressly stated to the contrary, refer to the East Coast of Scotland.

### I. The Spawning of the Food Fishes.

#### 1. *The Spawning Time.*

At various parts of the coast fishery officers have for two or three years kept records to show the numbers of male and female fish which they found to be ripe among a certain number examined, noting the place where the fish were captured, the date, and the condition of those not ripe—whether maturing or spent. By this system an exceedingly large number of fish have been examined, the records beginning early in 1889. I give in Table I. the results which I have tabulated from these records:—

TABLE I.—Showing the Numbers of Mature Fish (male and female) in different Months, and the Number Examined.

| Fish. | December. | | | | January. | | | | February. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Examined. | Ripe. | | Spent. | Examined. | Ripe. | | Spent. | Examined. | Ripe. | | Spent. |
| | | ♂ | ♀ | | | ♂ | ♀ | | | ♂ | ♀ | |
| Cod, . . . | 262 | ... | ... | ... | 1271 | 4 | 8 | ... | 1562 | 115 | 149 | 28 |
| Haddock, . . | 747 | ... | ... | ... | 1995 | 24 | 51 | 7 | 1891 | 212 | 322 | 16 |
| Whiting, . . . | ... | ... | ... | ... | ... | ... | ... | ... | 229 | ... | ... | ... |
| Ling, . . . | ... | ... | ... | ... | ... | ... | ... | ... | 265 | ... | ... | ... |
| Saithe, . . . | 63 | ... | ... | ... | 132 | 6 | 9 | 5 | 114 | 12 | 13 | 42 |
| Turbot, . . . | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| Brill, . . . | ... | ... | ... | ... | ... | .. | ... | ... | 6 | ... | ... | ... |
| Halibut, . . . | 3 | ... | ... | ... | 13 | ... | ... | ... | 14 | ... | ... | ... |
| Tusk, . . . | ... | ... | ... | ... | .. | ... | ... | ... | ... | ... | ... | ... |

* Seventh, Eighth, and Ninth Annual Reports.

† *Vide* the admirable and exhaustive report by this naturalist on the scientific investigations in connection with the recent survey of fishing grounds on the West Coast of Ireland, published in the Report of the Council of the Royal Dublin Society during the present year

TABLE I.—*continued.*

| Fish. | March. | | | | April. | | | | May. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Examined. | Ripe. | | Spent. | Examined. | Ripe. | | Spent. | Examined. | Ripe. | | Spent. |
| | | ♂ | ♀ | | | ♂ | ♀ | | | ♂ | ♀ | |
| Cod, . . . | 1240 | 258 | 239 | 332 | 2140 | 191 | 167 | 1511 | 1788 | 100 | 81 | 1434 |
| Haddock, . . | 2246 | 291 | 397 | 852 | 1766 | 69 | 94 | 1289 | 1147 | 6 | 3 | 984 |
| Whiting, . . . | 400 | 14 | 12 | 4 | 498 | 15 | 33 | 55 | 323 | 25 | 48 | 11 |
| Ling, . . . | 148 | 1 | ... | ... | 536 | 19 | 18 | 6 | 1140 | 103 | 81 | 97 |
| Saithe, . . . | 51 | 3 | 5 | 22 | 156 | 1 | 3 | 89 | 263 | ... | 1 | 222 |
| Turbot, . . . | 22 | ... | ... | ... | 57 | ... | 2 | ... | 169 | 14 | 19 | 8 |
| Brill, . . . | 22 | ... | ... | ... | 42 | 4 | 9 | ... | 14 | 2 | 8 | ... |
| Halibut, . . . | 6 | 1 | 2 | ... | 122 | ... | ... | 2 | 238 | 2 | 3 | 4 |
| Tusk, . . . | ... | ... | ... | ... | 12 | ... | ... | ... | 65 | ... | 22 | ... |

| Fish. | June. | | | | July. | | | | August. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Examined. | Ripe. | | Spent. | Examined. | Ripe. | | Spent. | Examined. | Ripe. | | Spent. |
| | | ♂ | ♀ | | | ♂ | ♀ | | | ♂ | ♀ | |
| Cod, . . . | 558 | 11 | 6 | 490 | ... | ... | ... | ... | ... | ... | ... | ... |
| Haddock, . . | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| Whiting, . . . | 344 | 34 | 26 | 183 | 132 | 5 | 5 | 112 | 60 | ... | 1 | ... |
| Ling, . . . | 371 | 75 | 48 | 67 | 46 | 7 | 4 | 10 | ... | ... | ... | ... |
| Saithe, . . . | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| Turbot, . . . | 180 | 28 | 48 | 31 | 10 | ... | 1 | ... | ... | ... | ... | ... |
| Brill, . . . | 130 | 7 | 11 | 80 | 7 | ... | ... | ... | ... | ... | ... | ... |
| Halibut, . . . | 213 | 3 | 2 | 3 | 42 | ... | ... | ... | ... | ... | ... | ... |
| Tusk . . . | 20 | 5 | ... | 6 | ... | ... | ... | 6 | ... | ... | ... | ... |

While in the records all the fish found to be quite mature are given, fish which have spawned are not always, although usually, mentioned. The proportions of mature fish—male and female together—to the total number examined in the various months are as follows:—

TABLE II.—Showing the Percentage of Mature Fish in Various Months.

| Fish. | Decr. | Jan. | Feb. | March. | April. | May. | June. | July. | Aug. |
|---|---|---|---|---|---|---|---|---|---|
| Cod, . . . | 0·0 | 0·9 | 16·2 | 40·0 | 16·7 | 10·1 | 3·0 | ... | ... |
| Haddock, . . | 0·0 | 3·8 | 28·5 | 30·3 | 7·9 | 0·9 | ... | ... | ... |
| Whiting, . . | ... | ... | 0·0 | 6·5 | 9·6 | 22·6 | 17·4 | 7·5 | 1·6 |
| Ling, . . . | ... | ... | 0·0 | 0·7 | 6·9 | 16·1 | 33·1 | 23·9 | ... |
| Saithe, . . | 0·0 | 11·3 | 21·9 | 15·7 | 2·5 | 0·3 | ... | ... | ... |
| Turbot, . . | ... | ... | ... | 0·0 | 3·5 | 19·5 | 42·1 | 10·0 | ... |
| Brill, . . . | ... | ... | 0·0 | 0·0 | 30·9 | 71·4* | 13·8 | 0·0 | ... |
| Halibut, . . | 0·0 | 0·0 | 0·0 | 50·0* | 0·0 | 2·1 | 2·3 | 0·0 | ... |
| Tusk, . . . | ... | ... | ... | ... | 0·0 | 33·8* | 25·0* | ... | ... |

* The numbers are small in these cases.

In regard to halibut, I may say that the records do not show very definitely the spawning period; partly, no doubt, because the fish are in almost all cases sent to market unopened. The spawning time of this fish is not yet well enough investigated to enable me to define its limits; conclusions based upon a few ripe fish in one month may be misleading, and many of the June records speak of 'developing roe.' I may give briefly one or two general observations derived from the study of these records—(1) shoals which spawn inshore are usually earlier than shoals of the same species which spawn far from shore (*e.g.* cod, haddock, whiting); (2) different shoals may spawn in succession on the same ground—one week may furnish fish almost all mature or spent, and the next week, or the next again, fish of the same species just approaching maturity or mature; (3) as a general rule most species spawn earlier towards the south and on the west coast, *e.g.*, ling and cod in the Atlantic, west of Barra, are about a month earlier than in the North Sea. Plaice, on the other hand, seem to spawn earlier on the north coast than farther south; (4) mature haddock, whiting, and cod may be caught within a few miles of certain exposed parts of the east coast, but in some of the west coast lochs (*e.g.*, Loch Broom), while such fish may be obtained approaching maturity, none are caught quite ripe—they move seawards before spawning and return in a spent condition.

TABLE III.—Showing the Numbers examined on board the 'Garland,' and the Percentage of Ripe Specimens in Various Months.

| Fish. | January. | February. | March. | April. | May. | June. | July | August. | September. | October. | November. | December. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cod, . . . | 158<br>*0·0* | 418<br>*0·3* | 192<br>*0·0* | 86<br>*1·7* | 99<br>*0·0* | 86<br>*0·0* | . | . | . | . | . | . |
| Haddock, . . | 305<br>*0·0* | 167<br>*0·0* | 172<br>*6·0* | 119<br>*1·1* | 245<br>*0·4* | 138<br>*0·0* | . | . | . | | . | . |
| Whiting, . . | 98<br>*0·0* | 87<br>*0·0* | 141<br>*9·9* | 112<br>*30·3* | 233<br>*6·0* | 65<br>*4·6* | 128<br>*0·0* | . | . | . | . | . |
| Gurnard, . . | 10*<br>*40.0* | 12<br>*0·0* | 6<br>*0·0* | 52<br>*3·8* | 207<br>*14·5* | 196<br>*27·5* | 337<br>*10·9* | 305<br>*7·5* | 192<br>*0·0* | . | . | . |
| Plaice, . . | 137<br>*57·4*† | 252<br>*20·2*† | 278<br>*0·0* | 184<br>*0·0* | 267<br>*0·0* | . | . | . | . | . | . | 95<br>*0·0* |
| Lemon Sole, . | . | 46<br>*0·0* | 83<br>*0·0* | 48<br>*0·2* | 110<br>*9·0*‡ | 120<br>*7·5* | 146<br>*20·5*‡ | 85<br>*0·0* | 97<br>*4·1*‡ | 109<br>*0·0* | | . |
| Common Dab, . | 120<br>*0·0* | 143<br>*1·4* | 231<br>*4·7* | 150<br>*12·0* | 283<br>*20·5* | 190<br>*13·1* | 431<br>*2·3* | 283<br>*0·0* | . | . | . | . |
| Flounder, . | 12<br>*0·0* | 15<br>*26·6* | 146<br>*39·0* | 63<br>*49·2* | 68<br>*47·0* | 7<br>*12·0* | . | . | . | . | . | . |
| Witch Sole, . | 12<br>*0·0* | 20<br>*0·0* | 48<br>*0·0* | 20<br>*0·0* | 66<br>*6·0* | 36<br>*16·7* | 22<br>*45·4* | 23<br>*8·7* | 26<br>*0·0* | . | . | . |
| Long Rough Dab | 144<br>*3·9* | 217<br>*3·2* | 145<br>*20·0* | 179<br>*7·9* | 218<br>*1·3* | 72<br>*0·0* | . | . | . | . | . | 76<br>*0·0* |
| Turbot, . . | . | . | . | . | 11<br>*1·0* | 13<br>*15·4* | 3<br>*0·0* | 8<br>*0·0* | . | . | . | . |
| Brill, . . . | . | . | 7<br>*14·0* | 3<br>*0·0* | 2<br>*50·0* | . | . | . | . | . | . | . |

* At Smith Bank, Moray Frith, January 21–24, 1889, 'four females, all partly spent.'
† Ripe only at Moray Frith.
‡ Nearly all at Orkney or Moray Frith.

I pass now to give the results of the 'Garland's' work as to the spawning time, the records, which have been almost exclusively kept by Mr T. Scott, F.L.S., extending back to June 1888. From the fact that the 'Garland' is able to work, unless in exceptional weather, only near the shore during the spawning time, these figures by themselves throw little positive light on the spawning *time* of some of the food fishes, such as cod, haddock, &c., but they are important in regard to flat fish. The number of fish examined in each month, and the percentage of ripe fish to the total number examined in that month, are given in Table III.

The figures in the tables refer to the several spawning seasons which have occurred since the records were begun; there are slight differences in each year, apparently depending on the temperature.

In Plate VI. I have represented in graphic form the time and duration of spawning of the more important food fishes, the curves being founded chiefly upon the figures in the preceding Tables. It is interesting to compare the results with those obtained by Professor M'Intosh regarding the distribution of the ova (p. 300).

## 2. *The Spawning Places.*

Renewed study of the records confirms the conclusion previously reached—that the majority of the food fishes do not spawn within the territorial waters on the East Coast. I have tabulated all the fish examined at the various stations, with the following results:—Of nearly 900 cod examined during the spawning period, none of those caught within the Firth of Forth, St Andrews Bay, or other part of the territorial waters were mature; the few mature specimens were all obtained beyond the three-mile limit. The same is true of the haddock, of which over a thousand were examined; and also of the plaice, of which about a thousand were examined. Individuals approaching maturity, or spent, were obtained—especially plaice—but none were quite ripe. The mature fish appear to pass out from the territorial waters at the spawning time; but it is noteworthy that at this period some individuals of larger size than the smallest mature specimens remain within the Firth of Forth in an immature condition. It is somewhat different with the whiting. While the great majority spawn outside the territorial waters, or near the margin, a few quite ripe specimens, both male and female, are found within the limit, and even pretty far up the Firth of Forth (stations i. and ii.) The gurnard, on the other hand, spawns to a considerable extent within the Firth of Forth and St Andrews Bay; ripe specimens have been caught at all the stations, most abundantly, however, at the outer ones, and just beyond the three-mile limit. This fish appears to approach the inshore grounds at the spawning time, and to leave them late in autumn. Lemon soles also spawn to a small extent within the mouth of the Firth of Forth, but mostly beyond it. All the ripe specimens of the witch sole (*Pleuronectes cynoglossus*) were obtained outside the territorial zone. Spawning long rough dabs and common dabs are got at nearly all the stations, but are most numerous outside. The same may be said of the flounder, with this qualification—that spawning fish are rather more abundant within the territorial waters than without. The evidence in regard to the turbot, brill, and black sole is not sufficient from the small number of ripe fish obtained. One ripe female brill was obtained at the mouth of the Firth of Forth at station vi. on May 3, 1889; but this is the only example within the territorial waters. No ripe turbot has been

obtained within the limit. From the results of the observations of the Fishery officers, combined with those of the 'Garland,' there is little doubt that brill and turbot, like halibut, ling, and torsk spawn most at considerable distances from shore. I may say briefly, from all the evidence in my possession, that most of the common food fishes spawn beyond the three mile limit in the regions of the East Coast investigated; that the spawning shoals are very numerous from five or six to twenty and more miles offshore, and that there is abundance of evidence that spawning fish may be found at great distances out in the North Sea. The greatest distances at which *ripe* specimens were obtained, according to the officer's records, are as follows:—Cod and ling, 170 miles; turbot and halibut, 150 miles; brill, 50 miles; saithe, 100 miles (also within four or five miles); tusk, 65 miles; hake, 60 miles; skate, 90 miles; gurnard and lemon soles, 30 miles; 'flounder' (?), 45 miles; whiting, 60 miles; and haddock, 30 miles.*

The investigation of the offshore fishing and spawning grounds in the North Sea appears to me to be one of the most important duties to be undertaken in the interests of the fisheries in the near future.

## 2. The Size at which Sea Fishes become Mature.

Since the publication of my paper on immature fish in the *Eighth Annual Report*, investigations have been carried on elsewhere on this subject, especially by Mr Holt, in the work previously referred to, by Dr Petersen in Denmark, and by Mr J. T. Cunningham. The paper mentioned was meant as a contribution to the practical side of the question, and in drawing up a table giving the minimum sizes at maturity, the smallest ripe example of either sex—almost invariably a male—was selected as a measure. From the practical point of view of regulation, I still believe this to be reasonable and sufficient. I am aware that several naturalists, working at the subject, are of opinion that the female of every food-fish should be allowed to spawn, at least once, before it is subjected to the risk of being eaten; but this doctrine when applied indiscriminately to all kinds of fish, seems to me as injudicious in theory as it would be impossible in practice. The problem is how best to conserve and increase the food supply from the sea, and any action taken must be based upon economic considerations—guided, of course (but only guided) by the results of scientific inquiries. The problem is extremely complex, but it appears to me that only those fisheries which show signs of diminution—as indicated by statistics—require regulations of this kind. Take, for instance, one or two examples. In the great herring fishery of Scotland, the quantity of immature herrings caught last year amounted to rather over 25 per cent. of the total catch, and of a value to the fishermen, as near as can be calculated, of between £200,000 and £230,000. Probably not one of these herrings had ever produced an egg, and yet they supplied about 45,000 tons of wholesome and nutritious food. In some years the proportion of immature herrings was very much greater. Take, again, the cod. Last year the quantity landed in Scotland was about

* Desirous of ascertaining, if possible, something about the spawning of the conger, I sent a circular to the twenty-six Fishery officers around the coasts, inquiring if they had ever seen a female with ripe eggs, and the reply was in the negative—although nearly 12,000 cwts. were landed last year. They are sent to market unopened.

26,000 tons, for which the fishermen received nearly £190,000. It is not possible to state, except approximately, the proportional quantity of immature cod landed; but from the statistics of the Fishery Officers as to the quantity of 'large' and 'small' cod captured, it is probable that, at least, 7,000 tons—valued at about £45,000—consisted of fish which had never reproduced. Other examples might be given; yet there is not sufficient evidence to show that these fisheries are falling off to any extent; and, unless on economic grounds, it is as unreasonable to prohibit the sale of such immature fish as to prohibit the sale of the eggs of domestic fowls, of chickens, lamb, veal, &c. The food of civilised man consists, to a large extent, of immature organisms—both animal and vegetable. It is somewhat different with the valuable flat-fishes—turbot, soles, brill, plaice, &c.—the abundance of which is undoubtedly diminishing on the fishing grounds; but it would require very careful consideration before recommending that all individuals, even of these species under the size at which the females first begin to reproduce—namely, turbot under about 18 inches, brill under about 16 inches, plaice under about 15 inches, and soles under about 12 inches—should be prohibited from sale. These fish, considerably under the sizes given, furnish a large and valuable source of food supply. On the other hand, the preservation of small specimens of little comparative value to the public or the fishermen, as in Denmark and Italy, would be advisable. But as stated elsewhere, the crux of the immature fish question is not the selection of sizes, but the carrying out of any regulations beneficially. Simple prohibition, merely of the landing or sale of the fish, may do more harm than good; regulation, to be effective, should be exercised at the fishing grounds or in connection with the fishing, and when the difficulty of carrying out simple police regulations is remembered, it is clear that this obstacle will be very great.

In the preparation of the previous paper, the sizes of the sexes were considered separately, but were not so given, except, as an illustration, in the case of the plaice, in which it was pointed out that the smaller ripe specimens were invariably males, the smallest ripe female obtained being 20 inches long, as compared with the smallest ripe male, which was only 13 inches—the average size of the ripe males being 16·7 inches and of ripe females 24 inches.* It was intended to deal with this question in the paper on the Proportional Numbers and Sizes of the Sexes among Sea-Fishes,† but exigencies of time compelled only the totals to be given.

This omission has now been supplied by Mr Holt in the valuable paper previously mentioned, and, in the accompanying table (Table V.), similar data are given for fish on the East Coast of Scotland.

This table explains itself, but one or two points may be referred to. As pointed out two years ago (*Eighth Annual Report*, Part III., p. 162), any line of demarcation that we can draw between mature and immature individuals of the same species cannot be mathematically precise, so as to have, on one side of it, all those which are immature, and, on the other side, all those which have reached maturity. If the line is drawn at the smallest ripe individual, a number of those which have not yet become mature will be included among the mature; if it is drawn at the largest immature individual present in a spawning shoal, then a number of ripe specimens will be included among the immature. To assume that the relation between the sexual maturity of a fish and its size was absolutely constant in all individuals of the same sex would be to exclude the possibility of variation in a function notoriously variable. Hence amongst almost all

* *Eighth Annual Report*, Part III., p. 162, 1890.
† *Op. cit.*, p. 348.

the species mentioned in the table, and very markedly in some, instances are found in which, in the same haul of the net, immature individuals are captured considerably larger in size than the smallest which is ripe. There is evidence, however, in many cases, that this cannot be mere individual variation of the kind referred to. A few examples may be given. With the common dab, females from 5 to 13 or 14 inches may be got quite immature in the same haul with ripe females 6 inches long, *e.g.*, in one haul on May 27 of nine females, four, ranging in size from 8 to 14 inches, were fully mature, three, from 9 to 12 inches, were approaching maturity, and two of 13 and 9 inches were immature; in another haul six ripe specimens ranged from 5½ to 9 inches, seven, nearly ripe, from 5½ to 7 inches, and four, quite immature, also from 5¼ to 7 inches. So with the males; and similar examples might be given among plaice, lemon dabs, witch soles, flounder, and long rough dabs. In January, February, and March male plaice up to 16 inches long, and females up to 18 inches long, may be obtained from within the Forth and in St Andrews Bay, with the reproduction organs quite immature, although the fish are above the size at which sexual maturity generally occurs.

The determination of the size at which maturity is attained does not, of course, by itself, throw much light upon the age of the fish. Mr Cunningham has recently published the results of an investigation on this difficult question,* in which the measurements of certain fish confined in tanks, and whose age is known, are compared with those of others taken from the sea, the age of which may be in some cases fairly well calculated.

### 3. The Duration of Reproductive Life.

From Table V. it will be seen that, in almost every case, the ripe, or nearly ripe, male is smaller than the female, and that the range of difference varies in different species. Further, the *maximum* size is nearly always greater in the case of the female. Another point of interest is the difference between the minimum and maximum sizes of ripe, or nearly ripe, specimens of either sex, which throws light on the duration of the reproductive epoch in the life of the species. Thus, a male long rough dab (*Hippoglossoides limandoides*) may reach sexual maturity when only—or even probably under—four inches in length, and may continue sexually active until at least twelve inches long. A female of the same species may produce ripe ova when about 5 inches long, and may go on producing ova, probably once each year, until over 16 inches in length. A male cod may be ripe when only 18 inches long, and live sexually active until it is considerably over 40 inches in length. The facts in regard to other species may be gleaned from the Table. Unfortunately, we do not yet know very much about the rate of growth of fishes; but, from the observations of Dannevig, Cunningham, and others, it would appear that sexual maturity is rarely, if ever, reached during the first year of life, and generally not until the second or third year, and probably in some cases even later. If this is the case, there can be little doubt, from the figures given in the Table, that the duration of the reproductive period comprises a considerable number of years

* *Journal Marine Biol. Association*, Vol. ii. No. 3, 1892.

## 4.—The Sexual Relations of Sea Fishes.

In Table VI. the relative numbers and sizes of the sexes at maturity is given. In the paper in the *Eighth Annual Report*, the proportional size and numbers of the sexes were indicated in the case of a considerable number of species, and these are now supplemented in Table VI.

TABLE VI.—Showing the Proportions of Number and Size among the Sexes of certain Sea-Fish producing Pelagic and Demersal Ova.

| Fish. | Numbers Examined. | | Ratio of Females to each 100 Males. | Aver. Length in Inches. | | Ratio of Length of Females to Males at 100. |
|---|---|---|---|---|---|---|
| | Males. | Females. | | Males. | Females. | |
| **With Pelagic Ova** | | | | | | |
| Dragonet (*Callionymus lyra*), . . . | 8 | 22 | 275 | 8·4 | 7·7 | 91 |
| Common Gurnard (*Trigla gurnardus*), | 255 | 1044 | 409 | 10·86 | 11·77 | 108 |
| Cod (*Gadus morrhua*) . . . . | 410 | 547 | 133 | 21·39 | 20·45 | 95 |
| Haddock (*G. æglefinus*), . . . . | 476 | 899 | 188 | 13·97 | 13·82 | 98 |
| Bib (*Gadus luscus*), . . . . . | 29 | 59 | 204 | 7·7 | 7·66 | 99 |
| Whiting (*G. merlangus*), . . . . | 423 | 895 | 211 | 11·29 | 11·78 | 104 |
| Saithe (*G. virens*), . . . . . | 8 | 9 | ... | ... | ... | ... |
| Ling (*Molva vulgaris*), . . . . | 342 | 344 | ... | ... | ... | ... |
| Torsk (*Brosmius brosme*), . . . | 35 | 39 | ... | ... | ... | ... |
| Long Rough Dab (*H. limandoides*), . | 158 | 1330 | 842 | 6·35 | 8·43 | 132 |
| ,, ,, . . . . . . | 57 | 103 | 180 | 4·3 | 5·5 | 128 |
| Halibut (*Hippoglossus vulgaris*), . | 10 | 15 | 150 | ... | ... | ... |
| Turbot (*Rhombus maximus*), . . | 26 | 53 | 204 | 17·2 | 20·3 | 118 |
| ,, . . . . . . . . | 42 | 81 | 193 | ... | ... | ... |
| Brill (*R. lævis*), . . . . . | 18 | 16 | 89 | 18·2 | 22·4 | 123 |
| ,, . . . . . . . . | 19 | 38 | 200 | ... | ... | ... |
| Witch (*P. cynoglossus*), . . . . | 96 | 250 | 260 | 14·8 | 16·9 | 114 |
| Sail-fluke (*Arnoglossus megastoma*), . | 9 | 12 | 133 | 13·0 | 17·1 | 131 |
| Plaice (*P. platessa*), . . . . | 1355 | 1932 | 142 | 13·74 | 15·62 | 114 |
| Lemon Sole (*P. microcephalus*), . | 286 | 882 | 308 | 11·7 | 12·4 | 105 |
| Common Dab (*P. limanda*), . . | 522 | 1539 | 295 | 7·8 | 8·17 | 103 |
| ,, ,, . . . . . . | 34 | 52 | 153 | 5·4 | 5·5 | 102 |
| Flounder (*P. flesus*), . . . . | 193 | 119 | 62 | 8·8 | 11·1 | 126 |
| Little Sole (*Solea lutea*), . . . . | 18 | 20 | 111 | 3·19 | 3·95 | 123 |
| Angler (*Lophius piscatorius*), . . | 61 | 16 | 26 | 27·7 | 24·3 | 87 |
| **With Demersal Ova.** | | | | | | |
| Lumpsucker (*Cyclopterus lumpus*), . | 24 | 6 | 25 | 10·8 | 18·0 | 166 |
| Cat-fish (*Anarrhichas lupus*), . . | 33 | 26 | 79 | 29·4 | 27·6 | 87 |
| Lesser Sand-eel (*Ammodytes tobianus*), | 465 | 393 | 84 | 7·0 | 6·8* | 97 |
| Herring (*Clupea harengus*), . . | 1782* | 1774* | 99 | ... | ... | ... |
| Viviparous Blenny (*Zoarces viviparus*), | 12 | 14 | 116 | 8·5 | 9·7 | 114 |

* Records of Fishery Officers.

Further investigation has confirmed the proportions given in the previous paper where the number of specimens was at all large, with one notable exception, viz., the long rough dab. From the anomaly presented by the great disproportion of males in the previous enquiry (1 to 8), I was induced to have special hauls made with a small-meshed net. These have not perhaps been sufficient to elucidate the sexual proportions of this species exactly, but they show that the males are much more numerous than was supposed. A number of the males are very small, and they had escaped through the ordinary net used previously. It is a curious fact that the male long rough dab may reach sexual maturity when scarcely five inches long—some specimens were nearly half-matured when only three and a half inches in length; and a ripe female may be over sixteen inches. The same appears to be the case, but to a much less extent, with the common dab. The contrary anomaly of the flounders—excess of males—was likewise specially investigated, and the previous results fully confirmed. It is remarkable that this fish alone, among those producing pelagic ova, should have the males in greater numbers than the females; probably it is owing to the exceptional fecundity of the female, as suggested in my paper on Fecundity in last year's Report (p. 247).

An interesting point brought out in this table is the excess of females in fish producing pelagic ova, and the excess of males in fish producing demersal ova. In the Angler the males are also in excess. In studying the fecundity of different species I was struck with this circumstance, and made some observations as to the relative weight and volume of the testes and ovaries in the two classes referred to, and the results help to explain, I believe, the disparity both in number and size between the sexes. I give a few examples in the annexed table (Table VII.).

Among flat-fish especially, the disparity between the size or volume of the testes and ovaries is very great, as may be seen if ratios are made. For example, in the plaice, in the instances given, the weight of the female reproductive organ is more than twenty-six times that of the male reproductive organ; in the flounder it is about forty times, and so on. Probably with the common sole the disparity is much greater. Among some of the Gadidæ, the volume of the testis is relatively greater, especially in large individuals.*

On the other hand, among fish with demersal ova, the volume of the male organ is generally relatively greater—in many cases it is actually heavier than the ovaries (*e.g.*, herring, sand-eel).

Now, it appears to me that a certain relation can be established between these facts and the proportional number and sizes of the sexes, looking at the matter as a question of stowage of the quantity of the reproductive material required. The females in fish producing pelagic ova require all the space for the ripe ovaries which distend their bodies, while the comparatively small testes take up little room. Hence, in such fish this relationship is shown in the sexual proportions—sometimes by a greater number of females, or by their greater size, and generally in both these ways, but in different ratios in different species. Among fish with demersal ova we may have the testes heavier than the ovaries, as just said, and the proportional numbers of the sexes may be in such cases pretty equal. But in the lumpsucker, where the male is smaller than the female, and the testes smaller than the ovary, we find the males far more numerous than the females. Why should the amount of reproductive

* Mr Robert Duthie, the Assistant Officer at Shetland, when endeavouring to procure fertilised ova of the torsk, wrote that while there was abundance of ripe females, all the males landed were immature, possessing very small testes. When advised to tease up a portion of the testes, the ova were successfully fertilised, the small male organ being normal.

ATURITY. [One inch = 25·3995 millimetres.]

| rs Mature. | | | Spent. | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Females. | | | Males. | | | | Females. | | | |
| L. | S. | Av. | No. | L. | S. | Av. | No. | L. | S. | Av. |
| 9 | 8 | 8·5 | ... | ... | ... | ... | 1 | ... | ... | 6·5 |
| 18 | 8 | 12·2 | 1 | ... | ... | 16·0 | 24 | 15½ | 12 | 13·4 |
| 42 | 22 | 33·9 | ... | ... | ... | ... | 4 | 46 | 34 | 39·7 |
| 25 | 10 | 15·4 | ... | ... | ... | ... | 1 | ... | ... | 16·5 |
| 23½ | 8 | 13·1 | 3 | 13 | 11 | 12·3 | 11 | 16 | 11½ | 13·2 |
| 7 | 7 | 7·0 | ... | ... | ... | ... | ... | ... | ... | ... |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 36 | 30 | 33·0 | ... | ... | ... | ... | ... | ... | ... | ... |
| 42 | 24 | 32·4 | 2 | 42 | 38 | 40·0 | 6 | 36 | 26 | 32·3 |
| 45 | 34 | 38·7 | ... | ... | ... | ... | 1 | ... | ... | 26·0 |
| ... | ... | ... | ... | ... | ... | ... | 1 | 18¼ | ... | 18·2 |
| ... | ... | ... | ... | ... | ... | ... | 4 | 12 | 8 | 9·2 |
| 6 | 6 | 6·0 | ... | ... | ... | ... | ... | ... | ... | ... |
| | | | | | | | | | | |
| 14 | 5 | 8·7 | 3 | 7½ | 4½ | 5·8 | 182 | 14 | 5 | 9·3 |
| 26 | 16 | 21·0 | ... | ... | ... | ... | 5 | 28 | 23 | 25·8 |
| 26 | 18 | 23·1 | ... | ... | ... | ... | ... | ... | ... | ... |
| 18 | 18 | 18·0 | ... | ... | ... | ... | 2 | 23 | 23 | 23·0 |
| 27 | 13½ | 18·4 | 3 | 18 | 14 | 16·0 | 91 | 27 | 17 | 22·0 |
| 17½ | 8½ | 13·4 | ... | ... | ... | ... | 6 | 17½ | 10½ | 14·3 |
| 20½ | 14½ | 17·1 | ... | ... | ... | ... | 21 | 19 | 13 | 17·6 |
| 14½ | 5½ | 8·9 | ... | ... | ... | ... | 34 | 17 | 7 | 9·5 |
| 18 | 7 | 11·9 | 1 | ... | ... | 7·0 | 6 | 16 | 10 | 13·2 |
| 20 | 17½ | 19·0 | ... | ... | ... | ... | 3 | 20½ | 17 | 19·3 |
| 4½ | ... | 4·2 | ... | ... | ... | ... | ... | ... | ... | ... |
| 29 | 20 | 25·7 | ... | ... | ... | ... | ... | ... | ... | ... |
| 12 | 10 | 11·2 | ... | ... | ... | ... | ... | ... | ... | ... |
| 37 | ... | 37·0 | ... | ... | ... | ... | ... | ... | ... | ... |

TABLE VII.—Showing the relative Weights of the Male and Female Reproductive Organs in Various Species of Sea Fishes.

| Fish. | Date. | Length. | Gross Weight. | | Weight of Ovaries. | Weight of Testes. | Condition. |
|---|---|---|---|---|---|---|---|
| | | inches. | lbs. | oz. | grammes | grammes | |
| Gurnard, . | June 7 | 13½ | 0 | 11¼ | ... | 15 | Nearly ripe. |
| | ,, 7 | 12¼ | 0 | 9½ | ... | 5 | ,, ,, |
| | ,, 7 | 18 | 0 | 8¼ | ... | 5 | ,, ,, |
| | ,, 11 | 13½ | 0 | 13½ | 48·2 | ... | Ripe. |
| Cod, . . | Mar. 15 | 39 | 24 | 8 | ... | 846 | ,, |
| | ,, 15 | 21½ | 3 | 9½ | ... | 53 | Nearly ripe. |
| | ,, 15 | 29 | 11 | 7 | ... | 10·5 | Scarcely half ripe |
| | ,, 19 | 30½ | 8 | 8 | ... | 276·0 | Nearly ripe. |
| | ,, 15 | 38 | 23 | 8 | ... | 813·0 | ,, ,, |
| | ,, 13 | 38 | 25 | 8 | 2124 | ... | ,, ,, |
| Haddock, . | Jan. 25 | 19 | 2 | 6 | ... | 31·8 | Fully half ripe. |
| | ,, 25 | 21½ | 3 | 10 | ... | 32·3 | Nearly ripe. |
| | ,, 25 | 21½ | 3 | 2 | ... | 27·8 | ,, ,, |
| | Mar. 16 | 13¼ | 0 | 13 | ... | 4·7 | Ripe. |
| | ,, 16 | 15¼ | 1 | 5 | ... | 10·0 | Nearly ripe. |
| | ,, 16 | 14 | 0 | 14 | ... | 7·5 | ,, ,, |
| | ,, 8 | 27 | 6 | 8 | 356 | ... | Ripe. |
| Long Rough Dab, | Mar. 15 | 7½ | 0 | 2 | ... | 3·1 | Nearly ripe. |
| | ,, 15 | 8 | 0 | 2¼ | ... | 4·8 | ,, ,, |
| | ,, 15 | 6½ | 0 | 1 | ... | 0·3 | ,, ,, |
| | ,, 12 | 8¾ | 0 | 3·1 | 14 | ... | Ripe. |
| Plaice, | Jan. | 21 | 3 | 8¼ | ... | 29·5 | Nearly ripe. |
| | ,, | 16¼ | 1 | 12 | ... | 14·2 | ,, ,, |
| | ,, | 15 | 1 | 6 | ... | 12·3 | ,, ,, |
| | ,, | 23¾ | 5 | 11 | 503 | ... | ,, ,, |
| Lemon Sole, . | Mar. 21 | 12¾ | 0 | 12 | ... | 2·2 | ,, ,, |
| | May 29 | 15 | 2 | 8 | 126·9 | ... | ,, ,, |
| Witch, . . | Mar. 18 | 16 | 1 | 1 | ... | 4·4 | ,, ,, |
| | ,, 18 | 17¼ | 1 | 8 | ... | 5·2 | ,, ,, |
| | May 22 | 19 | 2 | 0 | 151·2 | ... | ,, ,, |
| Common Dab, . | Mar. 16 | 8 | 0 | 2½ | ... | 0·8 | ,, ,, |
| | ,, 16 | 7¼ | 0 | 2 | ... | 0·7 | ,, ,, |
| | ,, 16 | 7 | 0 | 2 | ... | 0·6 | Ripe. |
| | May 12 | 8½ | 0 | 3½ | 8·8 | ... | ,, |
| Flounder, . . | Mar. 15 | 11½ | 0 | 9½ | ... | 4·7 | ,, |
| | ,, | 14¾ | 1 | 9½ | 187·4 | ... | ,, |
| Lump-sucker, . | Feb. 18 | 11½ | 2 | 1¼ | ... | 56·6 | ,, |
| | ,, 18 | 12 | 2 | 6 | ... | 70·8 | Nearly ripe. |
| | ,, 18 | 8½ | 0 | 12½ | ... | 23·9 | ,, ,, |
| | , 13 | 12 | 2 | 9½ | ... | 60·0 | ,, ,, |
| | ,, 19 | 17 | 7 | 8 | 878 | ... | Ripe. |
| Lesser Sand-eel, . | June | * 7 | 292 grs. | | ... | 3·2 | Nearly ripe. |
| | ,, | † 6·8 | 229 ,, | | 2·8 | ... | ,, ,, |
| Herring, . . | Feb. | *11·2 | 2701 ,, | | ... | 35·6 | Ripe. |
| | ,, | ‡11·2 | 2767 ,, | | 35·0 | ... | ,, |

* Average of 10 specimens.
† Average of 14 specimens.
‡ Average of 16 specimens.

Q

material produced by a given *proportion* of the males among fish with demersal ova be relatively so much greater than among fish with pelagic ova? The duration of the spawning period in a given individual in the two cases will not explain it. Demersal ova may be emitted in successive crops, and the number emitted *at one time* is probably as great with pelagic ova. The maturation of the spermatozoa is, no doubt, much more rapid than the maturation of the ova; but this argument would apply to both cases. It might be supposed that the mode or conditions of reproduction would furnish a clue; fish with demersal ova having generally a closer individual sexual relation than fish with pelagic ova. Nevertheless, considerations of monogamy, mixogamy, &c., do not explain the matter; for the herring and sand-eel—in which the preponderance of the male element is marked—are quite as mixogamous as the plaice or the gurnard. The difference is probably due to the spermatic fluid having a specific gravity less than that of the sea-water. With pelagic ova possessing an inferior micropyle, and passing through many fathoms of water to the surface, fertilisation by the upwardly-moving sperms will probably entail less loss of the latter than in the fertilisation of demersal ova lying on the bottom, and sometimes aggregated in masses. In the one case the action of gravity goes hand in hand with the intrinsic movement of the sperms. But in the other case each sperm must, so to speak, fight its way to the micropyle of the demersal ovum against physical opposition.

### 5. Sexual Coloration.

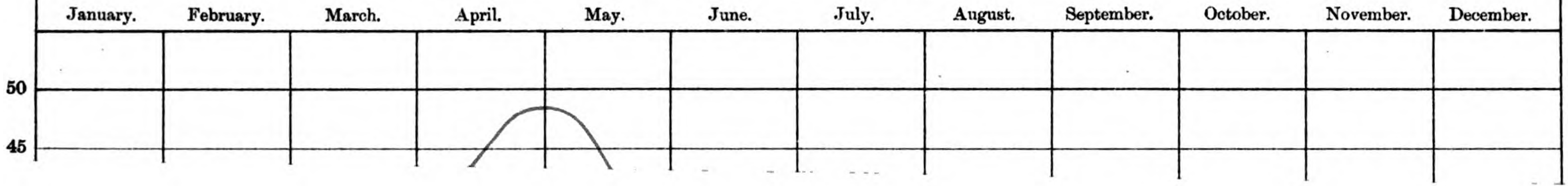
Some observations have been made on this subject which may be briefly referred to here. The coloration of many fishes may be, in a wide manner, classified according to three regions—the ventral, dorsal, and lateral. The dorsal colours are nearly always protective—a fact noticeable as much in pelagic, and freely roaming forms, as among flat fishes and shore forms. The ventral colour, or rather, absence of colour, is also protective in the majority of cases, in function, if not in origin, as may be observed in looking up at, say, a whiting or a herring poised in the water. The absence of colour may be due to the absence of light; and Cunningham's important observations on the production of pigment on the lower surface of young flat fishes by lighting them from below, are of much interest in this connection. The contrary does not hold good, for the young *Zoarces* extracted from the mother, or at the period of birth, have well-marked characteristic pigmentation dorsally and laterally, although they were previously cut off from the influence of light. Ventral coloration may, however, in some cases be sexual or other than protective. Lateral coloration may be sexual, although in several cases such coloration invades both the dorsal and the ventral surfaces. On the other hand, lateral coloration appears in some cases, at least, to have relation to the 'instinct' of shoaling, as among herring and mackerel. For instance, if a herring is held by the head and tail, and looked down upon, the coloration is dull and protective, as it is gradually raised, opposite the light, and the lateral surface comes into view, the characteristic iridiscence catches the eye at a certain angle, and the silvery sheen; but as the fish is moved upwards the iridiscence is lost, and, when viewed from below, the dullish white protective appearance is only visible. Examination of males and females revealed no distinction in coloration. So with the mackerel, where the lateral banding and sheen are distinct; with the sprat, the sand-eel, the smelt, the salmon, &c. From the fact that fish are, in this connection, largely cut off from the guidance of the sense which is so useful to herd-

PLATE VI.

## SHOWING THE SPAWNING PERIODS OF THE FOOD FISHES ON THE EAST COAST.

**Black = Round Fishes ; Red = Flat Fishes.**

1. Saithe.
2. Haddock.
3. Cod.
4. Whiting.
5. Ling.
6. Gurnard.
7. Plaice.
8. Lemon Sole.
9. Common Dab.
10. Flounder.
11. Witch Sole.
12. Long Rough Dab.
13. Brill.
14. Turbot.



ing animals—that of smell—I am disposed to think that this lateral sheen and non-sexual coloration is useful in keeping shoals of the same species together. It is well known that shoals of sprats and young herrings keep well defined and separate, unless in rough weather, which may drive them together, but they afterwards separate.

In regard to sexual colours proper, it is noteworthy that they are absent in almost all forms producing pelagic ova; and indeed, as might be anticipated, in all those whose reproduction is mixogamous (where the ova of each female are normally impregnated by the spermatozoa of many different males), as in the Gadidæ, Pleuronectidæ, herring, smelt, sand-eel, &c. There is a striking exception in the skulpin or dragonet (*Callionymus lyra*), which produces isolated pelagic ova, and in which the sexes are markedly dissimilar, and this puzzled me much until I came across an observation of Saville Kent's, who had watched the process of impregnation. A male and female at the spawning time were observed to rush upwards together in the water with their ventral surfaces closely apposed; and reproduction is hence not mixogamous. Sexual colour seems to be associated with the male, only when the eggs of a certain female can be impregnated by one individual male, and it is characteristic of many fish with demersal ova (lumpsucker, *Cottus*, Stickleback, Salmonidæ, &c.), and the region, or mode, in which this form of coloration is manifested is usually such as to interfere as little as possible with the protective coloration, *e.g.*, lumpsucker. In *Cottus scorpius*, the brilliant markings in the male, resembling the wing of a tiger moth, are confined to the region posterior to the pectoral fin, and to the under surface of that fin, and can be concealed by it. There is one point to be noted, that this form of coloration is not limited to the surface in some forms. In the male lumpsucker, where the abdomen is coloured at the spawning time, the rosy hue gradually pervades every tissue of the body—bones, cartilage, muscle, &c., and even tints the spermatic fluid. In *Cottus bubalis*, where the female is also brilliantly tinted, the internal parts are greenish.

It is further noteworthy that in many of those forms in which the impregnation of the demersal ova may be accomplished usually by a single male, the ova themselves are often brightly tinted—(*Agonus*, *Cyclopterus*, *Liparis*, *Salmo*, *Syngnathus*, *Gastrosteus*, &c.) That this is not due merely to participation in a general colour change, such as occurs in the male lumpsucker, is shown by the fact that the female of the same species is quite devoid of bright coloration, and yet produces a mass of beautiful rosy ova. This coloration can scarcely be protective.* The pigmentation of the ova in such cases is probably connected with the sexual function of the male—either of impregnation or of guardianship.

* In several cases, at least, the mass of pinkish ova of the lumpsucker begins to lose this colour on the surface after deposition, and passes to greenish or brownish, a tint which may serve for protection, by simulation of the colour of seaweeds, &c. This change appears to be due to the action of light; when a mass, which is green on the surface, is broken up, the interior may be found rosy; and by exposing one side of a portion to the light, and keeping the other side in darkness, I found that the exposed side lost its rosy hue, which was retained by the darkened portion; and even single ova showed the change on the opposite sides.

## III.—ADDITIONS TO THE FAUNA OF THE FIRTH OF FORTH.

PART IV. By THOMAS SCOTT, F.L.S. (Plates VII.-XIII.).

This, the fourth contribution towards a better knowledge of the fauna of the Firth of Forth, especially the invertebrate fauna, includes among other interesting forms several species of *Copepoda* now described for the first time, as well as a few not previously recorded for the east of Scotland; also a few species of *Amphipoda*, rare, or not previously recorded for the East Coast.

The species here recorded or described for the first time for the Firth of Forth comprise 25 species of *Copepoda*, 9 species of *Amphipoda*, and a rare species of *Actiniadæ*.

A description (with figures) is also given of a species of *Copepod* previously recorded in Part III. of the Eighth Annual Report, p. 320, in order to indicate more satisfactorily its position in the classification.

In the preparation of this paper I have again the pleasure of gratefully acknowledging the kindness of Professor G. S. Brady, F.R.S., also of the Rev. A. M. Norman, F.R.S., Rev. T. R. R. Stebbing, M.A., and A. O. Walker, F.L.S. I am also much indebted to Dr T. Wemyss Fulton, whose active interest in and sympathy with my work is a source of much encouragement. I also desire to say that not a little of my success in the study of the organisms recorded in this paper is due to the hearty co-operation of Captain R. E. Simpson, and to the intelligent interest shown by the mate in the investigations carried out on board the 'Garland.' My son, Mr A. Scott, has prepared the drawings which accompany this paper. He has also largely assisted me with the preparation of the dissections (a troublesome work) from which the drawings were made. Without the drawings it would have been difficult to realise the important and striking characters of the species mentioned, even though these characters have been, where necessary, fully described.

### CRUSTACEA.

### I. COPEPODA.

### GNATHOSTOMA.

#### *Family* CALANIDÆ.

*Acartia bifilosus* (Giesbrecht). (Pl. VII. fig. 14).

1881. *Dias bifilosus*, Giesbrecht, 'Die Freilebenden Copepoden der Kieler Foehrde,' p. 147, pl. iii. figs. 4, 22, 23, &c.*

*Habitat.*—In the vicinity of Culross, near the head of the Forth estuary, a number of specimens were obtained among material collected with a small beam-trawl-like tow-net, designed by Professor M'Intosh,† and worked from a rowing or small sailing boat. *Acartia bifilosus* closely resembles *Acartia longiremis*, and requires to be very carefully diagnosed to distinguish it from that species. The inner spines of the fifth pair of

* *Vierter Bericht der Commission zur wissenchaftlichen Untersuchung. der deutschen Meere, in Kiel*, 1887–1881.

† We find this net a most effective apparatus for capturing micro-organisms and young fish should any be present to capture.

feet in the female of *A. longiremis* are usually long and bent, or geniculate, near the middle; in *A. bifilosus*, on the other hand, the inner spines are much shorter and are not geniculate (fig. 14). The male fifth feet do not differ much in the two species, except that in *A. bifilosus* they are rather stouter than those of *A. longiremis*. The caudal stylets are usually shorter in *A. bifilosus*, and the last thoracic segment appears to be destitute of setæ. After examining a large number of specimens of both forms, I find the difference between them to be comparatively unimportant, and coincide with Dr Brady in considering the differences as of varietal value only. The characters which distinguish *Acartia discaudata* (Giesbrecht)—a form which I have already recorded from the Forth—are more marked, and show a greater divergence from *A. longiremis*.

*Eurytemora affinis* (Poppe).

1881. *Temora affinis*, S.A. Poppe, Ueber Eine nene Art der Calanaden-Gattung *Temora*, Baird, p. 55, pl. iii. figs. 1–14. ‡

1881. *Eurytemora hirundo*, Giesbrecht, *loc. cit.*, p. 152,§ pl. ii. figs. 7, 12, 19, &c.

1891. *Eurytemora affinis*, Brady, Brit. F.-W. Cyclop. and Calan., p. 42, pl. xiii. figs. 6–9. ¶

*Habitat.*—In the upper reaches of the Forth, about Culross and between Kincardine-on-Forth and Alloa. It was moderately common in some townettings collected in July 1891, and again in February this year (1892). ♂ and ♀ were nearly equally common, and many of the latter were carrying ova-sacs. *Eurytemora affinis* is readily distinguished from other British species of *Calanidæ* by the elongate abdomen (which is thickly clothed with very small stout setæ) and caudal stylets. The terminal spines of the swimming feet are very faintly serrate on the outer margin.

It is strange that the occurrence of *Eurytemora affinis*, which is such an easily distinguished species, should have been so long overlooked, especially as it is at times comparatively common in the upper parts of the Forth estuary.

*Stephos*, nov. gen. (provisional name).**

Like *Pseudocalanus*, except in the following particulars:—

The anterior antennæ are twenty-four-jointed. The female possesses a fifth pair of feet, which are simple, one-branched, and two-jointed, and the same on both sides. The fifth pair in the male form powerful grasping organs; they are one-branched and dissimilar on the two sides.

The posterior antennæ and mouth organs are similar to those of *Calanus*. The outer branches of the first four pairs of swimming feet are three-jointed, the inner branches of the first pair are one-jointed, of the second pair two-jointed, of the third and fourth pairs three-jointed as in *Pseudocalanus*.

*Stephos minor* (nov. gen. et sp. provisional name). (Pl. VII. figs. 1–13.)

Length ·74 mm. ($\frac{1}{34}$ of an inch). Cephalothorax robust, the body segment about half as long again as the combined length of the next three. Forehead rounded. Anterior antennæ about as long as the cephalothorax,

‡ *Abhandl. des Naturn. Ver.*, Bremen, vii.

§ See also *loc. cit.*, p. 167.

¶ *Nat. Hist. Trans., Northumb., Durham, and Newcastle-upon-Tyne*, vol. xi. Part I.

** Στεφος garland. After the name of our little steamer—the Garland—by means of which we have, with more or less success, investigated the fauna of the Forth.

twenty-four-jointed, the proportional length of the joints as in the formula

| | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 18 | 20 | 6 | 6 | 5 | 5 | 5 | 7 | 4 | 4 | 4 | 7 | 6 | 7 | 6 | 6 | 5 | 5 | 6 | 6 | 7 | 9 | 10 | 8 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |

Sparingly setiferous; there appears to be a depressed lobe-like process upon the distal end of the first or proximal end of the second joint (fig. 2). Antennæ the same in both sexes; posterior antennæ nearly as in *Calanus finmarchicus*, but the primary branch is somewhat shorter proportionally; mouth organs also as in that species. First four pairs of swimming feet as in *Pseudocalanus elongatus*, fifth pair in the female simple, one-branched, two-jointed, small; first joint about one and a half time longer than broad; the second joint about twice as long as the first, diminishing in breadth from the base to the apex, and bearing two small marginal spines —one opposite the other—on the distal half. The female fifth feet resemble somewhat those of *Candace pectinata*. Fifth pair of feet in the male long and forming a powerful grasping organ; both feet are one-branched and four-jointed; the two last joints of the right foot are elongate and slender, the ultimate joint being strongly curved outward in its upper half and forming a long powerful claw. The left foot is rather shorter than the other, and terminates in two digitiform processes between which the claw-like terminal joint of the right foot interlocks. Abdomen short; in the female four-, in the male five-jointed, the last segment shorter than either of the others. Caudal stylets short, length about equal to the breadth, and furnished with four long subequal setæ, and a few small hairs.

*Habitat.*—Off St Monans, Firth of Forth. Several specimens were obtained.

This comes very near *Pseudocalanus*, and but for the presence of a fifth pair of feet in the female, and the powerfully developed fifth feet of the male, would have become a member of that genus; as it is, the affinities of *Stephos minor* seem to be with *Pseudocalanus* on the one hand, and *Candace* or *Acartia* on the other.

### *Family* Misophriadæ, Brady (1878).

*Pseudocyclopia*, nov. gen. (provisional name).

Body robust, and resembling *Pseudocyclops* in general appearance. Head anchylosed with thorax. Basal joint of the anterior antennæ very large and nearly half the entire length of the antenna. The primary branch of the posterior antennæ three-jointed, the middle joint long; secondary branch large but scarcely so long as the primary branch, five-jointed, the third and fourth joints small. Mouth organs nearly as in *Calanus*. The outer branches of the first four pairs of swimming feet three-jointed, and longer than the inner branches; the inner branch of the first pair one-jointed, of the second pair two-jointed, of the third and fourth pairs three-jointed; the first basal joint of the third pair bears a long stout spine on the inner distal angle, longer than the inner branch. The fifth pair of feet in the female are small, one-branched, two-jointed, the first joint short, subrotund; the fifth feet in the male, elongate, one- or two-branched, unequal on the two sides, and forming powerful grasping organs. Abdomen in the female four-, in the male five-jointed.

*Pseudocyclopia crassicornis*, n. sp. (provisional name). (Pl. VII. figs. 15–29).

Length, exclusive of caudal setæ, ·66 mm. Cephalo-thorax robust, four-jointed, the first segment more than twice the combined length of the other three. Abdomen small, five-jointed in the male, four-jointed in the female; rostrum short, directed downwards. Anterior antennæ short,

sixteen-jointed; basal joint large and furnished with three elongate, stout, marginal sensory filaments and several small setæ; the second, sixth, tenth, and last joints are each also provided with a sensory filament, but smaller than those of the basal joint. The proportional length of the joints are very nearly as shown by the annexed formula

$$\frac{60 \cdot 6 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \cdot 4 \cdot 4 \cdot 4 \cdot 4 \cdot 4 \cdot 4 \cdot 6 \cdot 8 \cdot 6 \cdot 6}{1 \cdot 2 \cdot 3 \cdot 4 \cdot 5 \cdot 6 \cdot 7 \cdot 8 \cdot 9 \cdot 10 \cdot 11 \cdot 12 \cdot 13 \cdot 14 \cdot 15 \cdot 16}$$

Posterior antennæ three-jointed, the middle joint elongate with two small setæ on the exterior margin, and the last joint with a number of apical setæ. Secondary branch large, five-jointed, but shorter than the primary branch, the third and fourth joints very small. Mandibles small, consisting of a broad biting part, and a two-branched palp—one of the branches being two-, the other three-jointed. Anterior foot-jaw small, four-jointed, with several marginal setiferous processes. The basal joint of the posterior foot jaw elongate, the lower distal angle produced, with a blunt tooth-like process; second joint also elongate, slender; the last four joints small and setiferous. The outer branch of the first pair of swimming feet three-jointed, each joint armed with a stout spine at the outer distal angle, the inner branch one-jointed and rather longer than the first joint of the outer branch. The outer branch of the second pair is also three-jointed. Each of the first and second joints bear one, and the last joint four, stout spines of variable length, that of the second joint and the terminal spine of the last joint being larger than the others; the inner branch is two-jointed and shorter than the outer one, and the first joint is rather smaller than the second. The third and fourth pairs have both branches three-jointed. A stout and nearly straight spine—longer than the inner branch—springs from the inner distal angle of the first basal joint of the third pair, otherwise the third and fourth pairs are similar. The fifth pair in the female is one-branched, two-jointed, the first joint short and somewhat dilated; the extremity of the second is produced into two elongate spiniform processes (these are not spines articulated to the end of the joint but are prolongations of it), the inner one much longer than the other; there is also a subapical spine exterior to the two processes and shorter than either. Fifth pair in the male also one-branched, four-jointed, and elongate; that of the left (?) very slender. The first joint of the right (?) foot is short and dilated, the second and third long, the last very small and furnished with a marginal hooklet and a subapical digitiform process. Caudal stylets short, each bearing four long, plumose, terminal setæ, the two middle ones being stout and spiniform. *Spermatophore* elongate, narrow, curved, and showing under the microscope a beautifully reticulated structure (fig. 29).

*Habitat.*—Off St Monans, Firth of Forth. Several specimens were obtained.

*Pseudocyclopia minor*, n. sp. (provisional name). (Pl. VIII. figs. 1–10).

Length, exclusive of caudal setæ, ·43 mm. Cephalothorax robust, four-jointed, first segment large, more than twice the combined lengths of the other three. Anterior antennæ short, setiferous, seventeen-jointed, the basal joint large, provided with a hook-like spine on the outer margin and near the middle of the joint, and with a sensory filament at the outer distal angle; the fourth, seventh, ninth, and thirteenth joints are also each furnished with a small sense-organ. The proportional length of the joints are very nearly as shown in the annexed formula

$$\frac{30 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \cdot 2 \cdot 2 \cdot 3 \cdot 4 \cdot 3 \cdot 3}{1 \cdot 2 \cdot 3 \cdot 4 \cdot 5 \cdot 6 \cdot 7 \cdot 8 \cdot 9 \cdot 10 \cdot 11 \cdot 12 \cdot 13 \cdot 14 \cdot 15 \cdot 16 \cdot 17}.$$

Posterior antennæ three-jointed, middle joint long, secondary branch five-jointed, shorter than the primary branch. Mouth organs as in *Pseudocyclopia crassicornis*. In the first pair of swimming feet the first joint of the outer branch is about as long as the other two together, while the one-jointed inner branch is longer than the first joint of the outer one. Each of the three joints of the outer branch is armed with a large spine at the outer distal angle; both branches are furnished with several plumose setæ. The second pair is similar to those of *Pseudocyclopia crassicornis*. The third and fourth pairs are also similar to those of that species, but the spine which springs from the inner distal angle of the first basal joint of the third pair is curved, and is longer and more powerful, and extends beyond the extremity of the outer branch. The fifth pair of feet in the female are very small and somewhat resemble those of *Pseudocyclopia crassicornis*, but the extremity is bluntly rounded and provided with three spinous setæ, the middle one of which is the longest. The fifth pair in the male form very powerful grasping organs; the left (?) foot consists of two very long branches, one of which is four-jointed, and one five-jointed; the basal point of the first (the four-jointed branch) is moderately short and dilated, the second joint is very small, the third elongate and geniculate, and bearing a curved spine at the inner distal angle; the last joint is long and slender, with a rounded extremity; the third and fourth joints of the other branch (which is rather longer than the first) are elongate and slender, while the last joint is very short and produced into a digitiform process. The right (?) foot consists of a single four-jointed branch, the breadth of the first two joints of which is rather greater than the length; the third joint is elongate, and bears exteriorly on its lower half a dense fringe of plain spinous hairs, and two stout spines interiorly The last joint, which is very short, has three small subapical lobes. Abdomen in the male five-jointed, in the female four-jointed. The second and third joints of the female abdomen are produced posteriorly on each side of the median dorsal line into sharp angular processes as shown in the figures (fig. 9); the male abdomen wants the dorsal processes possessed by that of the female. Caudal stylets short, each furnished with four long, plumose, terminal hairs, the two middle ones being stout and spiniform.

*Habitat.*—Off St Monans, Firth of Forth Several specimens of this species were obtained

## *Family* HARPACTICIDÆ.

*Neobradya*, nov. gen. (provisional name).

Near *Bradya*, Boeck, in form and structure. Anterior antennæ nine- or ten-jointed, scarcely if at all longer than the first body segment; those of the male hinged and adapted for grasping. Posterior antennæ large, three-jointed; secondary branch of posterior antennæ, four-jointed, the first joint as long as the entire length of the other three. Mandibles well developed, possessing a broad biting part, and a large two-branched palp, one of the branches of which is one- and the other four-jointed. Maxillæ somewhat as in *Longipedia*. Anterior foot-jaws stout, five-jointed, the first joint rather longer than the second, and furnished with three digitiform lobes, the three last joints small. Posterior foot-jaws not uncinate, resembling somewhat those of *Bradya*. Both branches of the first pair of swimming feet three-jointed and about equal in length. The outer branches of the second, third, and fourth pairs three-jointed; the inner branches two-jointed; the fifth pair small foliaceous.

*Neobradya pectinifer**, nov. gen. et sp. (provisional name) (Pl. XIII. figs. 19–32).

*Female.*—Body elongate, cylindrical; length, exclusive of caudal stylets, 1·2 mm. and composed of nine segments. The first cephalo-thoracic segment longer than the next two together. Rostrum short, obtusely rounded. Anterior antennæ nine-jointed, about as long as the first body segment, stout, and well furnished with setæ; the proportional length of the joints are as shown by the formula

$$\frac{13 \cdot 22 \cdot 10 \cdot 5 \cdot 3 \cdot 4 \cdot 3 \cdot 2 \cdot 5}{1 \cdot 2 \cdot 3 \cdot 4 \cdot 5 \cdot 6 \cdot 7 \cdot 8 \cdot 9}.$$

One side of the fourth joint is produced to form the base of a long olfactory appendage. Posterior antennæ large, three-jointed, the extremity of the last joint furnished with one plain and five plumose hairs; the secondary branch is four-jointed; the first joint is as long as all the other three together; the first joint bears two setæ, the second and third one setæ each, and the last two very small marginal and two long terminal setæ. The mandible is well developed, having a broad biting part and a large two-branched palp—one of the branches is four-, the other one-jointed; both the basal part and the branches of the palp are furnished with setæ. Maxillæ nearly as in *Longipedia coronata.* Anterior foot-jaw stout, five-jointed, the first joint large and possessing three marginal digitiform lobes, each of the lobes with three strong, nearly equal terminal hairs, the second joint much smaller than the first, and produced to form a stout process similar to those on the first joint, and also, like them, provided with three stout, subequal, terminal hairs; the three last joints are very small, and furnished with four moderately long hairs. Posterior foot-jaws very small, three-jointed, armed with several appressed and short, stout, blunt-pointed, marginal spines, each of which is furnished with a fringe of short hairs arranged in a pectinate manner along the upper margin (fig. 27). All the swimming feet two-branched and nearly alike in both sexes. Both branches of the first pair of nearly equal length and three-jointed, the second, third, and fourth pairs have the outer branch three-jointed; the inner branch, which is rather shorter, is two-jointed, the first joint of both branches of the first four pairs longer than any of the other joints; the second joint of the basal part of each of the four pairs is very short, that of the first pair armed with a spine on the inner distal angle; that of the second, third, and fourth pairs provided with a small setæ instead of a spine; the last joint of each branch of all the four pairs is furnished with one or two long plumose setæ and one or two smaller hairs. Fifth pair of feet small, foliaceous, the produced inner portion of the basal joint rather smaller than the outer semicircular joint, and provided with two elongate, stout, plumose setæ of unequal length. The exterior lobe of the same joint bears a very long, slender, curved hair at its apex. A long, stout, plumose hair springs from the inner distal angle of the outer semicircular joint, and three others from its outer margin. Abdomen four-jointed, the first and third segments longer than either of the other two. Caudal stylets short and furnished with a long slender terminal hair and several very small ones.

*Male.*—The male differs little from the female except in the form of the anterior antennæ which are distinctly geniculated and form powerful grasping organs (fig. 22).

*Habitat.*—Off St Monans, Firth of Forth. Obtained from dredged material from 14 fathoms water.

* Referring to the comb-like arrangement of the hairs on the marginal spines of the posterior foot-jaws.

*Tachidius crassicornis*, n. sp. (provisional name). (Pl. VIII. figs. 14–27).

Length, exclusive of tail setæ, ·7 mm. Body moderately stout, first cephalo-thoracic segment longer than the next two together, the forehead produced into a short rostrum. Anterior antennæ shorter than the first body segment; that of the female six-jointed, stout, and densely setiferous towards the extremity, a small sensory filament springs from fifth joint. The proportional length of the joints are nearly as in the formula

$$\frac{20 \cdot 10 \cdot 9 \cdot 5 \cdot 3 \cdot 9}{1 \cdot 2 \cdot 3 \cdot 4 \cdot 5 \cdot 6}.$$

The anterior antennæ in the male form powerful grasping organs, closely resembling those of *Tachidius brevicornis* (fig. 17). Posterior antennæ short, three-jointed, the last joint nearly as long as the preceding two together; a small one-jointed secondary branch springs from the end of the first joint. Mouth organs nearly as in *Tachidius brevicornis*. The first four pairs of swimming feet nearly alike, both branches three-jointed, the first joint of the inner branches of all the four pairs smaller than either the second or third joints. The fifth pair in the female moderately large and foliaceous, furnished with three equal and plumose terminal seta; a plumose seta springs from a rounded basal part on the anterior margin of the female fifth pair, which may represent a rudimentary second branch. The fifth pair in the male are very small, subquadrate, and furnished with one small and two moderately long setæ near the inner angle and one at the outer angle; the first abdominal segment in the male is armed with prominent lateral appendages, which are easily observed without dissection, and which consist of a broad, but short, basal part bearing three unequal spiniform and plumose marginal setæ, the inner one being longer than either of the other two. Caudal stylets short, about as long as the last abdominal segment, and furnished with four setæ,—the inner and outer being plain and very small, the other two plumose and elongate; the inner of the two principal setæ is much longer than the other; and the basal part of the proximal half is broader than the remaining portion; the broad part, which is of nearly equal breadth throughout, merges abruptly into the more slender portion as shown in the figure. Ovisac single, large, with a number of large ova.

*Habitat.*—Near Culross on the upper estuary of the Forth; not very rare. Obtained February 1892.

This species comes near *Tachidius brevicornis* (Müller), but differs in the form of the anterior antennæ, which are rather stouter and shorter and six-jointed; in the first joint of the inner branches of the first four pairs of swimming feet being smaller than the other two joints; and in the form of the fifth feet in the female.

*Ameira longicaudata*,* n. sp. (provisional name). (Pl. IX. figs. 1–18).

Body slender; length, exclusive of tail setæ, 1 mm. (25th of an inch). Anterior margin of first body segment squarely truncate; forehead produced into a short blunt rostrum. Anterior antennæ longer than the first cephalo-thoracic segment, elongate, and sparingly setiferous; that of the female eight-jointed, of the male nine-jointed; the male antennæ are distinctly hinged between the sixth and seventh joints, and indistinctly between the third and fourth joints. A long sensory filament springs from the end of the fourth joint in both sexes; the porportional length of the joints of the female and male antennæ are nearly as in the annexed formulæ

* Referring to the long caudal stylets.

| | |
|---|---|
| Female | 30 · 19 · 14 · 10 · 5 · 8 · 5 · 10 |
| | 1 · 2 · 3 · 4 · 5 · 6 · 7 · 8 · 9 |
| Male | 30 · 19 · 10 · 14 · 3 · 7 · 8 · 4 · 10 |

Posterior antennæ of moderate length, three-jointed; joints nearly equal, a small one- (? or two-) jointed secondary branch springs from the end of the first joint, and bears three subequal terminal hairs; two of these hairs arise from a common and somewhat dilated basal part which may possibly represent a rudimentary second joint, but this is doubtful. Mandibles moderately stout, the biting part broad with several strong tooth-like processes, and a divergent, marginal, setiferous spine; the palp with two small branches and one or two terminal hairs. Maxillæ small; the terminal part, which is comparatively broad, is furnished with several spiniform teeth on the inner distal margin, and exteriorly with three small marginal setiferous lobes. Anterior foot-jaw small, two-jointed; the first joint with two marginal setiferous lobes, the last joint small and produced into an elongate slender process, bearing at its apex a stout plumose hair, and exteriorly, near the base, a plain slender seta. Posterior foot-jaw strong, and armed with a powerful clawed spine. The first four pairs of swimming feet have both branches three-jointed and elongate; the first joint of the inner branch of the first pair longer than the entire outer branch, and furnished with an elongate seta on the lower half of the inner margin; the two last joints are short, the second being the shorter of the two. Inner branches of each of the other three pairs shorter than the outer,—especially in those of the fourth pair; all the four pairs furnished with moderately long plumose setæ. The inner part of the basal joint of the female fifth pair moderately broad, furnished with four elongate setæ on its inner margin; the outer part is laterally produced and attenuated, and forms the base of a single elongate seta. The second joint is long and slender (fig. 12), and furnished with five setæ,—three on the outer margin, one on the inner margin near the apex, and an apical seta. The fifth pair in the male are very small; the basal joint is scarcely produced posteriorly, and bears three subterminal setæ the lateral produced part bears a single hair, the second joint narrow, ciliate on the outer margin, and furnished with one terminal seta, and another on the inner margin, both being of moderate length. The first abdominal segment bears two small setiferous lateral appendages, as shown in fig. 16. Caudal stylets elongate, slender, longer than the last abdominal segment, each with one extremely long and a few short terminal setæ. The posterior margins of all the cephalo-thoracic and abdominal segments are more or less distinctly denticulate.

A variety occurs, somewhat smaller than that described (figs. 17, 18), which has the antero-lateral angles of the first body segment rounded instead of angular; the posterior margins of all the body segments spiniferous instead of denticulate, and also armed at the postero-lateral angles with two strong spines and several small setæ. To distinguish this variety I have named it var. *spinosa*.

*Habitat.*—Off St Monans, Firth of Forth. Frequent. I first obtained this species two or three years ago, but for want of time to study its structure and affinities, it was laid aside, along with some others, till a more convenient season. With the assistance of my son, I am now able to describe this and several other interesting members of the Forth fauna.

*Paramesochra*,* nov. gen. (provisional name).

Body subpyriform; anterior antennæ short, seven-jointed in the female;

* Near *Mesochra*, Boeck, which it resembles in several important points, especially in the structure of the first four pairs of swimming feet.

modified, and forming powerful grasping organs in the male; posterior antennæ, with the primary branch three- or four-jointed, secondary branch very small, one-jointed. Mandibles well developed, and possessing a two-branched palp. Maxillæ small. Anterior foot-jaw with several marginal setiferous processes. Posterior foot-jaw small, feebly clawed. All the five pairs of swimming feet two-branched; both branches of the first pair two-jointed, the inner branch longer than the outer, first joint of the inner branch elongate, the last very small and imperfectly hinged; the outer branches of the second, third, and fourth pairs three-jointed, the inner branches two-jointed and shorter than the outer. Fifth pair foliaceous. The abdomen in the female four, in the male five jointed.

*Paramesochra dubia*, n. sp. (provisional name). (Pl. XII. figs. 18–32.)

*Female.*—Body subpyriform; length about ·65 mm. The postero-lateral angles of the cephalo-thoracic segment spiniform and produced backward beyond the next somite; two lenses—one on each side near the postero-lateral angles, as shown in the figure—can be easily made out with a $\frac{1}{4}$th or $\frac{1}{8}$th inch objective. Anterior antennæ short; seven-jointed basal joint very large and stout, the upper distal angle produced so as to form a stout prominent tooth, the remaining joints small, the proportional lengths of which are as shown in the formula

$$\frac{12 \cdot 4 \cdot 4 \cdot 3 \cdot 2 \cdot 3 \cdot 3}{1 \cdot 2 \cdot 3 \cdot 4 \cdot 5 \cdot 6 \cdot 7}.$$

Posterior antennæ three- (or four?) jointed; secondary branch small, slender, one-jointed. Mandible well developed, consisting of a biting part (the apex of which is armed with several long teeth) and a two-branched palp—one branch three- the other one-jointed. Maxillæ small, with a lateral two-jointed lobe, serrate at the apex, and an intermediate appendage furnished with two short terminal hairs. Anterior foot-jaw four-jointed, with several marginal setiferous processes; posterior foot-jaw three-jointed; last joint very small, and armed with three nearly equal setæ. All the five pairs of swimming feet two-branched; both branches of the first pair two-jointed; the outer branch of the second, third, and fourth pair three-jointed; the inner branch two-jointed; the first joint of the inner branch of the first pair elongate; the last very small and imperfectly hinged; inner branch longer than the outer one, the inner branch of the following three pairs shorter than the outer. The fifth pair foliaceous; basal joint large, its inner lobe with one plain and one plumose terminal seta. The exterior lobe, which is small, is also furnished with two small setæ; the second joint with four stout marginal hairs. Abdomen four-jointed; first segment large, composed of two coalescent joints; the last segment very small. Caudal stylets longer than the two last abdominal segments, and about six times longer than broad, furnished with one very long and three short unequal terminal hairs.

*Male.*—Rather smaller than the female; length about ·6 mm. Anterior antennæ forming powerful prehensile organs. The basal joint of the fifth pair of swimming feet much smaller than in the female, and wanting the two setæ. Abdomen five-jointed. With these exceptions the description of the female is equally applicable to the male.

*Habitat.*—Firth of Forth, west of May Island, February 1892. Several specimens were obtained.

*Tetragoniceps* (?) *maleolata*, Brady. (Plate VIII. figs. 11, 12.)

A Copepod answering to the description and figures of *Tetragoniceps maleolata*, except in the two following particulars, was obtained in material dredged off St Monans.

1st. The anterior antennæ are nine-jointed, four small joints precede the last one in the Forth specimen (fig. 11) instead of three as described for *Tetragoniceps maleolata.* 2d. The fifth pair of swimming feet are two-branched (fig. 12) in the Forth specimen, but in *T. maleolata* they are one-branched. This difference is a more important one than that between the anterior antennæ, because the one-branched fifth feet form one of the principal characters that distinguish *Tetragoniceps* from *Normanella.* Our specimen, even though possessing a three-jointed posterior antennæ, might have been ascribed to that genus, but the general contour of the animal is that of *Tetragoniceps,* and decidedly different from either *Normanella* or *Cletodes.* It is worth noting also that the general outline of the fifth foot of our specimen—leaving out of account its two-jointed structure—has a close resemblance to the fifth foot of *Tetragoniceps.*

*Tetragoniceps macronyx,*† n. sp. (Pl. X. fig. 19–28.)

Length, ·54 mm. ($\frac{1}{46}$th of an inch). Body slender. Rostrum small. Anterior antennæ slender, nine-jointed in the male, eight-jointed in the female, the proportional length of the joints as in the formula

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Male, . . . | 15 | 16 | 11 | 2 | 6 | 2 | 5 | 4 | 8 |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Female, . . | 15 | 15 | 3 | 15 | 5 | 5 | 5 | 9 | |

The male antennæ are hinged between the second and third and sixth and seventh joints. Posterior antennæ are of moderate length and three-jointed; secondary branch very rudimentary (fig. 22). Mandible palp small, one- or (?) two-branched. Anterior foot-jaw small, furnished with two marginal bi-lobed setiferous processes, and bearing at the apex a long, slender, filamentous hair and a claw-like spine. Posterior foot-jaw elongate, armed with a long, slender, sinuous, terminal clawed spine, which has a long delicate seta springing from its base. The outer branches of the first four pairs of swimming feet three-jointed—that of the first pair being shorter than those of the other three pairs; three slender subequal setæ spring from the end of the second joint of the outer branch of the fourth pair; the inner branch of the first pair are elongate, two-jointed; first joint nearly as long as the outer branch, and bearing a single delicate seta near the middle of the outer margin; second joint fully half the length of the first, and furnished with two elongate terminal hairs. The inner branches of the following three pairs are short, two-jointed, and armed with a moderately long, stout terminal spine. Feet of fifth pair foliaceous, elongate, narrow-triangular. Caudal stylets rather longer than the last abdominal segment, and furnished with a moderately long and a few small setæ. Ovisac single, and containing a few large ova.

*Habitat.*—Off St Monans, Firth of Forth. A few specimens only were obtained among dredged material from about 14 fathoms water, bottom clean sand.

*Tetragoniceps Bradyi,** n. sp. (Pl. IX. fig. 19–32.)

Length, exclusive of tail seta, 1 mm. ($\frac{1}{25}$th of an inch). In general form like *Tetragoniceps maleolata,* but the first cephalo-thoracic segment is scarcely so angular in front. Rostrum very short, anterior antennæ about as long as the first cephalo-thoracic segment, nine-jointed, the second joint produced into a strong claw on the under side (fig. 20); the proportional length of the joints are nearly as in the annexed formula

* The name is given in compliment to Professor G. S. Brady, who instituted the genus, and to whose untiring and disinterested kindness the author of these notes owes much of his success in the study of the Entomostraca.

† Μακρός, long, and ὄνυξ, claw, referring to the long claw of the posterior foot-jaw.

$$\frac{27 \cdot 10 \cdot 7 \cdot 5 \cdot 3 \cdot 3 \cdot 2 \cdot 2 \cdot 11}{1 \cdot 2 \cdot 3 \cdot 4 \cdot 5 \cdot 6 \cdot 7 \cdot 8 \cdot 9}.$$

The fourth joint is produced so as to form the base of a long and stout sensory filament. All the joints except the first are more or less setiferous. Posterior antennæ three-jointed, the joints subequal; a small secondary one-jointed branch springs from the end of the first joint. Mandible palp distinctly two-branched—one of the branches much larger than the other (fig. 22). Maxillæ with a broad biting part and a four-lobed branchial appendage. Anterior foot-jaw five-jointed; the broad first and second joints bear five marginal, digitiform, setiferous lobes arranged in two groups—three lobes in the one and two in the other, with a clear space between. The last three joints, which are very small, are furnished with a number of small setæ. Posterior foot-jaw three-jointed, last joint forming a base for a moderately long terminal claw and a small seta; a plumose seta springs from the inner margin, and near the middle of the second joint, anterior to the plumose seta, are a number of fine marginal cilia. The first joint is furnished with two subterminal plumose hairs. The first four pairs of swimming feet are nearly as in *Tetragoniceps maleolata*. The fifth pair, which are one-branched, are in the form of large, foliaceous concave plates, the length of which is about one-third the length of the whole animal (fig. 30). Their breadth is about equal to half their length. The extremity and outer margin are provided with a few setæ, the inner terminal seta being plumose, the others plain. A strong muscle extends down the exterior side and across the extremity, and sends off branches to the marginal setæ. Inclosed within the feet were a number of ova, having apparently no other covering than that of the enclosing large foliaceous plates. Abdomen five-jointed; the posterior ventral margin of the third segment is produced so as to form a prominent fold which extends about half-way over the next segment. Caudal stylets about as long as the last abdominal segment, and having the outer margin nearly straight and the inner strongly sigmoid; each stylet bears a long terminal seta, the base of which is considerably dilated, and a few very small hairs, as shown in figure 32. No males were obtained.

*Habitat.*—Off St Monans. Rare. The nine-jointed anterior antennæ, with the strong claw-like process of the second joint, together with the remarkably large, foliaceous fifth feet, render this a well-marked species.

*Tetragoniceps incertus.* (Pl. XII. figs. 1–17).

*Female.*—Body elongate, cylindrical; length, exclusive of caudal setæ, 1 mm. First cephalo-thoracic segment about as long as the next two together, forehead produced into a sharp-pointed rostrum. Anterior antennæ about as long as the first body segment, seven-jointed, the proportional length of the joints as shown in the formula

$$\frac{20 \cdot 18 \cdot 12 \cdot 7 \cdot 4 \cdot 5 \cdot 8}{1 \cdot 2 \cdot 3 \cdot 4 \cdot 5 \cdot 6 \cdot 7}.$$

All the joints except the first sparingly setiferous; a moderately long olfactory filament springs from the end of the fourth joint. Posterior antennæ short, two- (or three-?) jointed, and possessing a very small one-jointed secondary branch which bears two terminal setæ. The apex of the last joint of the primary branch is furnished with five setæ, the three longest of which are bent near the middle, the outer one of the three having a small forward-directed spine at the bend. Mandible dilated at the base, the apex truncate, and armed with several blunt-pointed teeth; mandible palp one-branched, long, and slender. Maxillæ small, simple, with

two small lateral appendages. Anterior foot-jaw small, armed with a stout curved terminal spine and two marginal setiferous lobes. Posterior foot-jaw uncinate, forming a moderately strong prehensile organ, the terminal claw slender and strongly curved. The inner branch of the first pair of swimming feet elongate, two-jointed, the last joint small, the first nearly twice the length of the three-jointed outer branch. A small seta springs from the inner margin of the second basal joint, and another from the inner margin and near the proximal end of the elongate first joint of the inner branch. Two slender hairs, one of which is setiferous, spring from the extremity of the last joint. Each of the three joints of the outer branch is armed near the exterior distal angle with a short spinous seta; three hairs —two of which are long and setiferous and bent near the middle—spring from the extremity of the last joint. The inner branches of the second, third, and fourth pairs are one-jointed, that of the fourth rudimentary; the outer branches are three-jointed, the joints subequal and more strongly setiferous than those of the first pair. Fifth pair foliaceous,—the same on the both sides,—one-branched, and furnished with three hairs on the outer margin and four on the inner—the upper of the four being densely setiferous. The extremity of each branch terminates in a stout blunt-pointed spine nearly as long as the branch to which it appears to be articulated. Abdomen four-jointed, the first segment composed of two coalescent joints, and about twice the length of the next two together, the second, third and fourth segments subequal. Caudal stylets fully half as long as the last abdominal segment, slightly divergent, each stylet furnished with a long geniculated terminal seta and several small hairs.

Male closely resembling the female but smaller (·87 mm). Anterior antennæ eight-jointed, the two first joints long, as in the female, the fifth shorter than any of the other joints, and furnished with an olfactory appendage. The antennæ are distinctly hinged between the sixth and seventh joints, and indistinctly hinged between the third and fourth. The posterior antennæ, mouth-organs, and first pair of swimming feet as in the female. The last joint of the outer branch of the second pair of swimming feet like that of the female, but furnished with an additional and moderately stout plumose hair, the normal position of which appears to be that shown in the figure (fig. 12). A long spiniform appendage springs from the basal joint of the third pair, and close to, but inside of, the one-jointed inner branch (fig. 14). This appendage is more than twice the length of the inner branch, and as long as the two first joints of the outer branch. The fifth pair of feet is furnished with fewer marginal hairs than those of the female, and the terminal spine seems to be continuous with, and not articulated to, the basal part of the foot. Abdomen five-jointed, caudal stylets and setæ as in the female.

*Laophonte horrida* (Norman).

1869–70. *Cleta minuticornis*, Buchholz, 'Die zweite deutsche Nord-polar-fahrt,' p. 393, pl. xv. fig. 3.

1876. *Cleta horrida*, Norman, 'Report of the Valorus Expedition,' p. 206 (Proc. Roy. Soc.).

1880. *Laophonte horrida*, Brady, *loc. cit.*, ii. p. 74, pl. xxiv. figs. 1–11.

*Habitat.*—Washed from a large root of sea-weed brought up in the trawl-net near the middle of the estuary between Fidra and St Monans during February last (1892). This remarkable species is readily distinguished by the strong dorsal armature of the body segments. The first pair of feet have the basal part long and rather slender. The rostrum

is prominent and has the apex somewhat tri-lobed; the middle lobe projects forward considerably beyond the lateral ones.

It has been obtained from various parts of Great Britain. The following are some of the localities—Off the Island of Cumbrae; at Portincross, Ayrshire; Mulroy Loch, Donegal (G. S. Brady); Oban (A. M. Norman); East Loch Tarbert, Loch Fyne (Mihi). *Laophonte horrida*, so far as I have been able to know its habits, is no swimmer, but appears to frequent the muddy roots of weed and zoophytes, among which it crawls and finds food and shelter; it is usually more or less coated with mud.

*Laophonte inopinata*,* n. sp. (provisional name). (Pl. XI. figs. 1–12.)

*Female.*—Length, exclusive of caudal setæ, ·5 mm. Viewed dorsally, the body is elongate and becoming gradually narrower posteriorly, composed of ten segments, the first segment about as long as the next three together, and furnished with a few small spinous setæ at the antero-lateral angles. Rostrum short, obtuse. Anterior antennæ short and stout, six-jointed, the first three joints large, subequal, the fourth and fifth small. The proportional length of the joints are as in the annexed formula

$$\frac{7 \cdot 8 \cdot 7 \cdot 2 \cdot 2 \cdot 6 \cdot}{1 \cdot 2 \cdot 3 \cdot 4 \cdot 5 \cdot 6}$$

The fourth joint produced on one side to form the base of an elongate olfactory filament. Posterior antennæ stout, three-jointed, with four long geniculated terminal setæ and one short curved terminal spine. The margin of the last joint is also fringed with short hairs and provided with a spine near the distal end. The secondary branch, which springs from near the middle of the second segment of the primary branch, is small, one-jointed, furnished with one marginal and three short, plumose terminal setæ. Anterior foot-jaw small, two-jointed, armed with a terminal clawed spine and two elongate marginal lobes. Posterior foot-jaw two-jointed, and bearing a long terminal claw. The first pair of swimming feet nearly as in *L. similis.* The second, third, and fourth pairs nearly alike, moderately stout; fifth pair small. The basal joint is furnished with several small marginal hairs, a moderately long plumose terminal hair, and three subterminal, spinous setæ toothed near the extremity; the second joint small and provided with one long and four short terminal hairs. Caudal stylets short, each with a long curved, spreading terminal seta, beset for two-thirds of its length with numerous wooly-like curled filaments; a short terminal seta plumose on one side; and a few very short hairs. The integument is thickly covered with minute hairs, and the posterior margins of the body segments are, besides being fringed with cilia, furnished with a number of small hairs placed at regular intervals along the margin of each segment as shown in the enlarged figure.

*Male.*—The chief difference between the female and male is in the form of the anterior antennæ, which in the latter are distinctly hinged, and constitute powerful grasping organs.

*Habitat.*—Washed from a large seaweed root brought up in the trawl-net a few miles west of May Island. Several ♂ and ♀ specimens were obtained; some of the latter carried ovisacs. The long, spreading, and neatly curved caudal setæ serve to distinguish this species at a glance, and especially so when examined under the microscope; the wooly-like curled filaments with which they are covered give them a very striking character.

* *Inopinata*, unexpected.

*Cletodes lata*,* n. sp. (provisional name). (Pl. X. figs. 10–18).

Length ·7 mm., body depressed, moderately broad, the last thoracic and first abdominal segments rather narrower than those that precede or follow; all the segments, but especially the three first abdominal segments, have the postero-lateral angles more or less sharply angular; the last abdominal segment nearly as long as the second and third together; the first body segment broadly triangular, the breadth being rather greater than the length. Anterior antennæ shorter than the first body segment, stout, six-jointed, the second and fourth joints smaller than any of the others, the proportional length of the joints as in the formula

$$\frac{10 \cdot 3 \cdot 8 \cdot 2 \cdot 4 \cdot 10}{1 \cdot 2 \cdot 3 \cdot 4 \cdot 5 \cdot 6}.$$

All the joints, with the exception of the first, are armed with stout spiniform setæ, and a stout elongate sensory filament springs from the third joint. Posterior antennæ two-jointed, secondary branch obsolete, and represented by a small hair arising from a slightly produced part of the margin, and near the middle of the first joint of the primary branch. Mandible with three strong teeth; mandible palp small, cylindrical, one-jointed (fig. 13). Posterior foot-paw furnished with a long slender curved terminal claw. The first joint of the outer branch of the first pair of swimming feet half as long again as either the second or the third joint; the inner branch, which consists of two short equal joints, is about as long as the first joint of the outer branch. The middle joint of the outer branches of the second, third, and fourth pairs is shorter than either the first or last joints; the first joint of the inner branches is not half the length of the second. Fifth pair foliaceous, the inner lobe of the basal joint broad, bearing two elongate, stout, subterminal setæ; the outer lobe is in the form of an elongate cylindrical process, bearing a moderately long terminal setæ; second joint elongate, ovate, the outer margin with three small hairs widely apart, a moderately long apical seta, and a very small hair on the inner margin. A variety (?) occurs having the second joint very narrow, with the apical and three marginal hairs very long. The caudal stylets short, widely apart, and bearing one moderately long and a few small setæ.

*Habitat.*—Off St Monans, Firth of Forth. Several specimens were obtained among dredged material.

*Thalestris harpactoides*, Claus. (Pl. XI. figs. 13–16).

1863. *Thalestris harpactoides*, Claus, 'Die frei lebenden Copepoden,' p. 133, pl. xix. figs. 2–12.

1880. *Thalestris harpactoides*, Brady, 'Brit. Copep.,' vol. ii. p. 127, pl. l. figs. 9–16; pl. lix. fig. 1.

*Habitat.*—Off St Monans, Firth of Forth. A few species were obtained among dredged material. It somewhat resembles *Th. rufocincta*, but is more slender. The colour of the Forth specimens was bluish. There is also a narrow but distinct belt, due to difference of colour or structure, along the margins of the body segments. Its slender form, the form of the posterior foot-jaws (fig. 13), of the first pair of feet, and of the fourth and fifth pairs, serve to distinguish this from other British species of *Thalestris*. The marginal spines of the outer branches of the second, third, and fourth swimming feet of *Th. rufocincta* are strongly setose, of *Th. harpactoides* finely ciliated. In the posterior foot-jaw in *Th. rufocincta* the terminal claw has three prominent though slender setæ spring-

* *Lata*, broad, referring to its comparatively broad outline when viewed dorsally.

ing from the base, but the terminal claw of the same appendage in *Th. harpactoides* is provided with only a single delicate seta. From *Th. mysis* this species is at once distinguished by the form of the fifth feet in both ♀ and ♂ specimens.

*Scutilidium fasciatum* (Boeck).

1864. *Porcilidium fasciatum*, Boeck, 'Oversigt Norges Copepoder,' p. 56.
1868. *Aspidiscus fasciatus*, Norman, 'Brit. Assoc. Report,' p. 298.
1880. *Scutilidium fasciatum*, Brady, 'Monog. Brit. Copep.,' ii. p. 178, pl. lxviii. fig. 11; pl. lxix. figs. 1–9.

*Habitat.*—In a shore-gathering from Dunbar, collected by Mr Peter Jamieson, assistant naturalist. This and *S. tisboides* may be distinguished from most other British Copepoda by the peculiar form of the first pair of feet.

*Cylindropsyllus lævis*, Brady (Pl. XIII. figs. 1–18.)

1880. *Cylindropsyllus lævis*, Brady, 'Monog. Brit. Copep.,' vol. iii.

*Female.*—Length 1·4 mm. Animal elongate, cylindrical, cephalo-thorax five-jointed, not distinctly separated from the abdomen, which is four-jointed; the first body segment about as long as the next two together; forehead produced into a sharp rostrum. Anterior antennæ short, scarcely longer than the first body segment, seven-jointed, the proportional length of the joints as in the formula

$$\frac{10 \cdot 22 \cdot 9 \cdot 6 \cdot 5 \cdot 4 \cdot 8}{1 \cdot 2 \cdot 3 \cdot 4 \cdot 5 \cdot 6 \cdot 7}$$

Sparingly setiferous, a long slender olfactory appendage springs from the end of the fifth joint. Posterior antennæ two-jointed, basal joint long and moderately stout, bearing near the proximal end a very small one-jointed secondary branch which is furnished with one long terminal setæ; the last joint of the primary branch is armed with several spiniform hairs. Three of those which spring from the extremity of the joint are long and bent near the middle, where, on the outer one of the three, is a produced spine-like process, which looks to be a continuation of the straight proximal half of the hair. Mandibles well developed, consisting of a stout biting part furnished with several small teeth, and a small one-branched palp bearing three moderately long terminal hairs. There is anterior to the mandibles a peculiar organ possessing at its anterior edge two subtriangular appendages which are crenate on the outer margin and measure in breadth very nearly ·01 mm. These subtriangular appendages resemble somewhat the sucking disks on the forehead of *Caligus* and may function as such, but this is very doubtful. Our dissection shows a slender muscle extending upwards and, terminating between the two appendages where it becomes dilated, and seems to connect the two.

The maxillæ (fig. 7) consist of flattened plates, ciliate on the inner margin, the cilia being bounded externally by a small spine. Anterior foot-jaws one-jointed, small, and furnished with one or two marginal processes; posterior foot-jaws stout, bearing a prominent, somewhat clawed terminal spine, and two marginal setiferous processes. Outer branches of first four pairs of swimming feet three-, inner branches two-jointed; fifth pair one-branched, foliaceous. (For description of swimming feet, caudal stylets, and setæ see 'British Copepoda,' iii. p. 30.) Ovisacs two, each containing three large ova arranged as shown in the figure. The integument

of cephalo-thorax and abdomen closely beset with minute papillæ, of which fig. 18 is an enlarged representation.

*Male.*—Body similar to that of the female but smaller (1·3 mm.). Anterior antennæ eight-jointed; the proportional length of the joints are as in the formula

$$\frac{10 \cdot 22 \cdot 5 \cdot 8 \cdot 3 \cdot 8 \cdot 5 \cdot 5}{1 \cdot 2 \cdot 3 \cdot 4 \cdot 5 \cdot 6 \cdot 7 \cdot 8};$$

distinctly hinged between the sixth and seventh joints, and indistinctly between the third and fourth. The fifth joint, which is very short, bears a long olfactory filament. The posterior antennæ, mouth organs, and first pair of swimming feet as in the female. The last joint of the outer branches of the second pair of swimming feet bears at nearly right angles a long curved appendage closely resembling the blade of a reaping-hook, and setose on the inner margin (fig. 13). The basal joint of the inner branches of the third pair is furnished internally with a long slender process, which extends beyond the extremity of the branch, and is armed on the inner margin near the distal end with two barb-like teeth. The fourth and fifth pairs as in the female, except that the fifth is rather smaller and furnished with fewer setæ. The abdomen five-jointed; the posterior margin of the first abdominal segment bears a foliaceous appendage armed with one long and two short, stout setæ. Caudal stylets and setæ as in the female.

*Habitat.*—Off St Monans, Firth of Forth, in 14 to 15 fathoms water; bottom clean course sand. Not uncommon.

This interesting Copepod, which was described by Professor Brady in his monograph of the British Copepoda in 1880, is apparently local in its distribution, and is probably rare as well as local. The generic and specific descriptions given in the monograph were prepared from the examination of one specimen only—a female—and, as pointed out by Professor Brady, both descriptions were necessarily somewhat incomplete. Having some time ago in a single haul with the dredge secured a considerable number of specimens including both males and females, the opportunity was taken advantage of to make a careful examination of both sexes so as to gain some knowledge of the affinities of the species. In the monograph alluded to *Cylindropsyllus* was provisionally placed among the *Pœcilostoma* because of its apparently close relationship to that group, but as the structure of some of the mouth organs had not been satisfactorily made out no distinct place in the classification was assigned to it.

By the careful dissection of a number of specimens I have been able, with the assistance of my son, to prepare a fairly complete description, with a set of drawings, of the more important and characteristic appendages that distinguish *Cylindropsyllus lævis* from other Copepoda. It will be observed by referring to the description and drawings that there are one or two characters which render the position of *Cylindropsyllus* among the *Pœcilostoma* untenable. These are the distinctly hinged male anterior antennæ, the presence of a secondary branch on the posterior antennæ, and the form of the mandibles,—characters which indicate a closer affinity with the *Harpacticidæ* than with either the *Pœcilostoma* or the *Siphonostoma*. If, on the other hand, the appendages of the peculiar organ described as situated anterior to the mandibles be sucking disks, the position of *Cylindropsyllus* in the classification would be somewhat anomalous, as these appendages would indicate a tendency towards parasitism in this Copepod,—a tendency suggested by Dr Brady. No indication of parasitical habits has, however, been observed hitherto in any of the specimens obtained.

*Cylindropsyllus minor.* (Pl. XI. figs. 17–24).

*Female.*—In the female the body is cylindrical and elongate. Length, exclusive of tail setæ, 1 mm., the first thoracic segment nearly as long as the next three together, rostrum short with a rounded apex. Anterior antennæ about as long as the first thoracic segment, seven-jointed; the comparative length of the joints are as shown in the formula

$$\frac{7 \cdot 18 \cdot 9 \cdot 4 \cdot 5 \cdot 4 \cdot 8}{1 \,.\, 2 \,.\, 3 \,.\, 4 \,.\, 5 \,.\, 6 \,.\, 7}.$$

Sparingly setiferous. An olfactory filament springs from the end of the fourth joint, which is produced to form a base for the filament. The posterior antennæ, mandibles, maxillæ, and anterior foot-jaws as in *Tetragoniceps incertus.* Posterior foot-jaw two-jointed and armed with a long, stout, terminal claw which is ciliate on the inner margin of the distal half. A spine springs from the end of the first joint and projects forward so as to be opposed to the extremity of the terminal claw. The outer branch of the first four pairs of swimming feet three-jointed, the inner branch of the first and fourth pairs two-jointed, of the second and third one-jointed, the inner and outer branches of first pair nearly equal, but the inner rather longer, sparingly setiferous. The one-jointed inner branch of the second and third pairs shorter than the first joint of the outer branch, and terminating in a short stout spine; a moderately long slender hair springs from near the middle of the one-jointed inner branch of the third pair. The outer branch of the fourth pair is nearly twice as long as that of any of the preceding pairs. The two first joints are about equal in length; the last is rather shorter, and furnished with one very short and three long setæ. The inner branch, which is two-jointed, is scarcely longer than the first joint of the outer branch, and provided with a short terminal plumose spine or stout setæ. Fifth pair foliaceous, small, one-branched, the posterior margin armed with six plain setæ, and, exteriorly, with a stout spine. Abdomen four-jointed, first segment rather longer than any of the other three. Caudal stylets about as long as the last abdominal segment, slightly divergent, and bearing a lanceolate spiniform terminal process and a few very small hairs. Ovisacs two, each with four ova placed end to end as shown in the figure.

(?) *Lichomolgus littoralis,** n. sp. (Pl. X. figs. 1–9).

*Male.*—Length about 1·12 mm. (exclusive of tail setæ). In form somewhat like *Lichomolgus arenicolus.* Anterior antennæ short, seven-jointed, the proportional length of the joints as shown by the formula †

$$\frac{16 \cdot 24 \cdot 12 \cdot 23 \cdot 15 \cdot 18 \cdot 16}{1 \cdot 2 \cdot 3 \cdot 4 \cdot 5 \cdot 6 \cdot 7}.$$

All the joints more or less setiferous; the second joint is furnished with a number of moderately short, and two long setæ. Posterior antennæ stout, four-jointed, the length of the joints gradually decreasing, the last about as broad as long, quadrangular, and bearing about six long, unequal, and plain terminal hairs and one plumose seta, the exterior margin of the second and third joints ciliated. Two spines, one of which is stout and strongly curved, and two setæ, spring from the exterior distal angle of the third joint as shown in the figure. There is no secondary appendage to the posterior antennæ. Mandible stout, consisting of a broad

* Of or belonging to the shore.

† When first examined the three last joints of the anterior antennæ were observed to be nearly equal in length, but the last one became detached before the joints were measured. The length stated, though closely approximate, may therefore not be quite correct.

basal part (from the end of which spring two submarginal plumose setæ) and a strong claw-like tooth armed with a few setæ on its outer aspect, as shown in the figure. Maxillæ well developed, the biting part with three apical processes, finely serrate on the margin, the palp with several terminal plumose setæ. Second foot-jaw strong, two-jointed, last joint broadly triangular, the inner margin armed with a double row of small teeth, terminal claw stout, curved, as long as the joint from which it springs, and forming with it a powerful grasping organ; the first joint is provided with a stout plumose seta on the inner margin. Both branches of the first four pairs of swimming feet three-jointed and nearly alike; the outer branch rather shorter than the inner. The fifth pair broadly foliaceous, truncate at the end, and furnished with four stout terminal hairs; both the margins are ciliated. Abdomen five-jointed, the first segment considerably larger than the next, and armed with two short unequal spines at the postero-distal angles; the last four segments gradually decrease in length and breadth. Caudal stylets short and broad, about as long as the last abdominal segment, and furnished with one long and two short terminal plumose setæ and three very short hairs.

*Habitat.*—Vicinity of Culross, on the north side of the Forth. One specimen only was obtained. The remarkable form of the posterior foot-jaws, so closely resembling the Gnathopods of some of the Amphipoda, and the broad fifth pair of swimming feet, enable the species to be readily distinguished. A full-sized drawing of the animal was to have been prepared, but unfortunately the cover-glass of the slide on which the Copepod was mounted preparatory to being figured was accidentally pressed down so that the thorax became abnormally flattened; for this reason a correct full-sized drawing could not be prepared.

3

*Lichomolgus concinnus*,* n. sp. (provisional name). (Pl. XI. figs. 25–~~2~~3).

*Female.*—Length, exclusive of caudal setæ, ·9 mm. Cephalo-thorax broadly ovate. Abdomen short, narrow, four-jointed, first abdominal segment large, longer than the following three together, and as broad as long, the postero-lateral angles not produced nor furnished with spines. Caudal stylets stout, about as long as the last abdominal segment, and provided each with one marginal and four terminal setæ. Forehead rounded. Anterior antennæ shorter than the first cephalo-thoracic segment, seven-jointed, sparingly setiferous, the proportional length of the joints as in the formula

$$\frac{12 \cdot 28 \cdot 7 \cdot 18 \cdot 15 \cdot 12 \cdot 7}{1 \cdot 2 \cdot 3 \cdot 4 \cdot 5 \cdot 6 \cdot 7}.$$

A short olfactory filament springs from near the middle of the fifth joint. Posterior antennæ stout, four-jointed, and armed with a short and strong terminal claw; the second joint is longer than the next two together, the third is small. There is no secondary branch. The anterior foot-jaw is in the form of an elongate curved spine, having a dilated base and a long slender extremity; it resembles in form and marginal pectination the anterior foot-jaw of *Lichomolgus liber*. Posterior foot-jaw three-jointed, similar to that of *L. thorellii*. Second joint dilated and bearing two slender spines; the last joint smaller, with two stout terminal spines, one of which is setose. The first three pairs of swimming feet as in *L. liber*, the inner branch of the fourth pair two-jointed, the second joint twice as long as the first. The foot of the fifth pair consists of a stout cylindrical joint bearing two elongate terminal hairs, which are articulated near the base; ovisacs two. No male has been observed.

*Habitat.*—Off St Monans, Firth of Forth. Rare.

* *Concinnus*, neat.

*Lichomolgus arenicolus*, Brady.

1872. *Boeckia arenicola*, Brady, 'Nat. Hist. Trans. Northumb. 'and Durham,' vol. iv. p. 430.
1880. *Lichomolgus arenicolus*, *idem.*, 'Brit. Copep.,' vol. iii. p. 46, pl. lxxxvii. fig. 1–7.

*Habitat.*—Off St Monans, Firth of Forth. One specimen only of this fine and distinct species was obtained. It occurred among material dredged in about 14 fathoms water; bottom, clean sand.

*Cyclopicera gracilicauda*, Brady.

1880. *Cyclopicera gracilicauda*, Brady, *loc. cit.*, vol. iii. p. 58, pl. lxxxiii. figs. 1–10.

*Habitat.*—Off St Monans, Firth of Forth. Several specimens were obtained among dredged material. This was readily recognised by the slender abdomen and long caudal stylets. It appears to be a somewhat rare species.

## PARASITA.

### *Family* CHONDRACANTHIDÆ.

*Chondracanthus zei*, Delaroche.

1811. *Chondracanthus zei*, Delaroche, 'Nouv. Bull. des Sc. de la 'Soc. Philm.,' vol. ii. p. 270, t. 2, fig. 2.
1850. *Chondracanthus zei*, Baird, 'Brit. Entom.,' p. 327, pl. xxxv. fig. 1.

*Habitat.*—On the gills of a 'John Dory' (*Zeus faber*), caught in the vicinity of Largo Bay, Firth of Forth. Baird (*loc. cit.*) gives a very characteristic figure of this *Chondracanthus*. The arrangement of the numerous elongate appendages (they can scarcely be called spines as Baird describes them) which surround the parasite is such as to impart to it a somewhat handsome appearance. There does not appear to be any previous record of this species from the Firth of Forth.

*Chrondracanthus merluccii*, Holten.

From the skin of the branchial cavity of a Hake. *Merlucius vulgaris*, landed at Newhaven, February 1885.

## AMPHIPODA.

### *Family* GAMMARIDÆ.

*Cressa dubia* (Spence Bate) Pl. VIII. fig. 13.

1855. *Montagua dubia*, Spence Bate, 'Report Brit. Assoc.'
1857. *Danaia dubia*, *idem.*, 'Ann. and Mag. Nat. Hist.,' xix. p. 137.
1870. *Cressa schiodtei*, Boeck, 'Crust. Amph. bor et Arct.'

*Habitat.*—From a large 'root' of *Laminaria* brought up in the trawl-net at Station V., Firth of Forth, in February 1892. Several specimens were obtained. From what I can learn regarding this species it appears to be somewhat rare in the British seas. It was first obtained by Spence Bate among trawl refuse 'from near the Eddystone Lighthouse.' David Robertson records having taken it 'off stones and nest of *Lima hians*

'that were dredged in 7 to 8 fathoms west of Tan Bouy, Cumbrae,' and he adds, 'This was the only time I met with it.'*

In 'British Sessile-eyed Crustacea,' vol. i. p. 67, it is stated in the generic description of *Danaia* that the mandibles are 'destitute of a palpi-'form appendage.' That is not so. They possess an elongate three-jointed palp (fig. ) which has somehow been overlooked by the author when preparing the description of the genus. The Rev. T. R. R. Stebbing in his valuable work on the Challenger Amphipoda, referring to this genus in a foot-note at p. 1671 (vol. xxix. of the Challenger Reports), points out that 'in 1849 'Milne Edwards and J. Haime, ("Comptes Rendus," t. xxix. p. 261), gave 'the name *Dania* to a genus of fossil Corals; this name they spell '*Danaia* in the general index to their Monograph of the British Fossil 'Corals, Palæont. Soc. vol. for 1854, published 1865. *Danaia*, Spence 'Bate, must therefore give way to the later Cressa, Boeck, with which a 'specimen of the type species recently obtained and dissected proves it to 'be certainly synonymous.' See also a foot-note at p. 747 of Mr Stebbing's work referred to above.

***Halimedon parvimanus*** (Bate and Westwood).

1862. *Westwoodilla cæcula*, Bate, 'Cat. Amphip. Brit. Mus.,' p. 102.
1862. *Westwoodilla hyalina*, *idem*, *ibedem*, p. 103.
1863. *Œdiceros parvimanus*, Sp. Bate and Westwood, 'Brit. Sess.-'eyed Crust.,' vol. i. p. 161.
1870. *Halimedon Mülleri*, A. Boeck, 'Crust. Amphip. bor. et 'Arct.,' p. 89.
1889. *Halimedon parvimanus*, Norman, 'Ann. and Mag.,' S. 6, vol. iii, p. 455, pl. xx. figs. 10–14.

*Habitat.*—From trawl refuse from Station V., Firth of Forth, February 1892, and on one or two previous occasions from other parts of the Forth. This species seems to be rare in the Forth, as only one specimen at a time has been obtained. The Forth specimens agree very closely with the figures and description in the 'British Sessile-eyed Crustacea,' in having the Gnathopods distinctly subchelate, the rostrum strongly produced, the eye large and near the apex of the rostrum.

***Pontocrates haplocheles*** (Grube).

1864. *Kroyeria haplocheles*, Grube, 'Die Insel Lussin und ihre 'Meeresfauna. Nach einen sech wöchentlichen aufenthalte ges-'childert, von Dr Adolph Eduard Grube.' Breslau, 1864.
1868. *Kroyera brevicarpa*, Bate and Westwood, 'Brit. Sess.-eyed 'Crust.,' vol. ii. p. 508.
1870. *Pontocrates haplocheles*, Boeck, 'Crust. Amphip. bor. et Arct.'

*Habitat.*—Largo Bay, dredged 1889. One specimen only of this apparently rare amphipod was obtained. In this species the first Gnathopods are short and comparatively broad, and the produced part of the carpus terminates in a distinct finger-like process. The propodos of the second Gnathopods are long and slender; the lower angle of the carpus is very little produced, which thus differs from other British species of *Pontocrates* that have the lower angle of the carpus of the second Gnathopods produced as far as, or beyond, the extremity of the propodos. In *Pontocrates haplocheles* the lower produced part of the propodos, which forms the palm of the *chela*, consists of two distinct portions, the outer or lower is much more slender than the other, and terminates in a slightly curved point a little beyond the end of the *chela*. This structure, which seems to be

* Amphipoda and Isopoda of the Clyde, p. 15 (1888).

indicated by the double line in the drawing of the second Gnathopod at p. 508 of the second vol. of 'Brit. Sess.-eyed Crust.,' can only be satisfactorily observed with a moderately high power of the microscope, as a $\frac{1}{4}$ or $\frac{1}{5}$ inch objective. This species has been taken at Banff by Thomas Edward.

*Haustorius arenarius* (Slabber).

1769. *Oniscus arenarius*, D. M. Slabber, 'Natuurkundige Verlustigingen behelzende microscopise Waarneemingen van in-*en* uitlandse water-en Land-Dieren, elf de Stukje,' pp. 92–96. Te Haarlem (1769).

1775. *Haustorius arenarius*, P. L. S. Müller. A Translation into German (with Notes) of Slabber's work. Pub. Nürnberg.

1818. *Lepidactylis dytiscus*, T. Say, 'An Account of the Crust of the U.S.A.' (Jour. Acad. Nat. Sc. Phil.)

1825. *Pterygocera arenaria*, P. A. Latreille, 'Fam. nat. Reg. Animal.,' &c.

1851. *Bellia arenaria*, Spence Bate, 'Ann. and Mag. Nat. Hist.,' ser. 2, vol. vii. pp. 318–320, pl. xi. figs. 1–8; pl. x. fig. 10.

1854. *Sulcator arenarius*, *idem*, *ibidem*, vol. xiii. p. 504.

1863. *Sulcator arenarius*, Bate and Westwood, 'Brit. Sess.-eyed Crust.,' vol. i.

1880. *Lepidactylis arenarius*, S. J. Smith, 'Trans. Connecticut Acad.,' vol. iv. (July 1880).

1888. *Haustorius arenarius*, Stebbing, 'Report on the Amphipoda of the Challenger Expedition,' vol. xxix. (text, first half), p. 39. (Notes on Müller's translation of Slabber's work.)

*Habitat.*—Sandy shore east of Burntisland. This species seems to be rather uncommon within the Forth area. There does not appear to be any previous record of it from the Forth. I obtained it by digging up the sand down to 4 or 5 inches, and then passing the sand through a fine wire sieve. It 'has been taken near Falmouth by Dr Leach; at Moray Firth by the Rev. G. Gordon; on the coast of Cumberland by Mr Albany Hancock; and in Oxwick Bay by Mr Moggridge and Dr J. Gwyn Jeffreys.'* Mr David Robertson of Cumbrae records it as 'moderately common all round our sandy shores near low water, and taken most successfully by the sieve.'†

It will be observed from the references given that this pretty Amphipod has received a considerable amount of attention from authors. Rev. Mr Stebbing remarks (*loc. cit.*): 'The excellent name *Sulcator* might well have been allowed to stand, but since that has been displaced on grounds of priority, first by *Pterygocera* and then by *Lepidactylis*, it seems only just to go back a step farther to Müller's *Haustorius*.' I have adopted this very reasonable proposal.

*Melphidippa* (?) *spinosa* (Goes).

1865. *Gammarus spinosus*, Goes, 'Crust. Amphip. Spitsb.'

1870. *Melphidippa spinosa*, Boeck, 'Crust. Amphib. bor. et Arct.'

*Habitat.*—Firth of Forth, west of May Island, taken with tow-net fixed to the head of the beam trawl. This appears to be a rare species in the Firth of Forth. It somewhat resembles *Dexamine* or *Atylus*. The one or two specimens I have observed in the Forth were, when captured, of a bright red colour, but from some cause none of them were perfect.

* Amphipoda and Isopoda of the Clyde, p. 28 (1888).
† *Idem.*

*Gammarus marinus*, Leach.

1815. *Gammarus marinus*, Leach, 'Linn. Trans.,' vol. xi. p. 359.
1863. *Gammarus marinus*, Bate and Westwood, 'Brit. Sess.-eyed 'Crust.,' vol. i. p. 370.

*Habitat.*—Firth of Forth, inshore, in the vicinity of Culross. *Gammarus marinus* is easily distinguished by the very short inner ramus of the posterior pleiopoda. This species does not appear to have been previously recorded for the Forth, though it is not uncommon towards the head of the estuary, especially where there are sea-weeds between the tide marks.

*Photis longicaudata* (Bate and Westwood).

1863. *Eiscladus longicaudatus*, Bate and Westwood, 'Brit. Sess.-'eyed Crust.,' vol. i. p. 412.
1877. *Photis longicaudata*, Meinert, 'Crust. Isop. Amphip. et 'Decapoda Daniæ.'

*Habitat.*—Firth of Forth, off St Monans. Several specimens were obtained by dredging.

*Family* HYPERIIDÆ.

*Parathemisto gracilipes* (Norman).

1868. *Hyperia oblivia*, Bate and Westwood (non Kröyer), 'Brit. 'Sess.-eyed Crust.,' vol. ii. p. 16.
1869. *Hyperia gracilipes*, Norman, 'Report on dredging among the 'Shetland Islands (in Report of the 38th Meeting of the Brit. 'Assoc., 1868.' London 1869).
1887. *Parathemisto longipes*, Bovollius, 'Sytem. list of the Amphip. 'Hyperiidea' (Behang till K. svenska Vet.-Akhad. Handlingar. Band. 11, No. 16. Stockholm 1887).

*Habitat.*—Largo Bay. A number of specimens taken with tow-net. The specimens here ascribed to *Parathemisto gracilipes*, Norman, are small (4 to 5 mm.), apparently all ♂, and most of them with ova. They differ in several respects from *Parathemisto oblivia*, Kröyer, and particularly in the carpus of the second Gnathopods being much less produced inferiorly,—the carpal process being only about one-third of the length of the propodos;—and in the pereiopods being less slender and not so elongate proportionally. Rev. T. R. R. Stebbing, who kindly examined one or two specimens for me, writes:—'The Small Hyperid is apparently *Parathemisto gracilipes*, Norman, wrongly described and named *Hyperia oblivia*, Kröyer, in B. and W.'

*Euthemisto compressa* (Goes).

1865. *Themisto compressa*, Goes, 'Øfvers. af Kgl. Svenska Vetensk 'Akad. førhandl.,' p. 533, pl. xli. fig. 34.
1870. *Parathemisto compressa*, Boeck, 'Crust. Amph. bor. et Arct.' (Særskilt aftryht af Vidensk. Selsk. Forhandlinger).
? 1878. *Lestrigonus spinidorsalis*, Sp. Bate, 'Ann. and Mag. Nat. 'Hist.' (May 1878), p. 411, fig. 2.
1890. *Euthemisto compressa*, G. O. Sars, 'Crustacea of Norway,' vol. i. p. 12, pl. v. fig. 2.

*Habitat.*—West of May Island, February 1892. This species was obtained among tow-net material collected when trawling Station V. Attention was first drawn to it by its larger size and darker colour than *Parathemisto oblivio*. It is readily distinguished by the body being much compressed, by the dorsum being distinctly keeled, and by the two last segments of the percion and the two first of the pleon being produced

posteriorly in the median dorsal line into more or less sharp tooth-like processes. The posterior pleopods have the outer ramus much shorter than the inner.

The name *Euthemisto* was established by Dr Bovallius in 1887 to replace *Themisto*, Guiérin (1828), which was pre-occupied. Professor G. O. Sars describes three species of *Euthemisto* as belonging to the Norwegian Fauna.

Rev. Mr Stebbing suggests that the *Lestrigonus spinidorsalis*, Spence Bate, from the Aberdeenshire coast, and recorded in the *Annals and Magazine of Natural History* for May 1878, is the *Euthemisto compressa* (Goes). There seems to be little doubt that Mr Stebbing's suggestion is correct.

## Zoantharia.

*Cerianthus lloydii* (Gosse).

*Habitat.*—Off St Monans, in about 14 fathoms water; bottom clean, but not very fine sand. Fragments consisting of the head and tentacles of this sea anemone have been obtained on one or two occasions among sand dredged at the locality mentioned. I have obtained the same species at extreme low water in Rothesay Bay near the Royal Aquarium, but in this case also it was only the head part. The difficulty of capturing a whole specimen is indicated by the following remarks of Mr Robertson of Millport—'It must be approached with the greatest caution, and a spade 'or other such implement placed in the gentlest manner 4 or 5 inches 'from the spot where it is, and when all is ready, drive the spade suddenly 'in beneath it, cutting off its escape by passing through the tube. If the 'animal takes the alarm before the thrust is made, I should say, speaking 'from my own experience, that it is almost hopeless to follow up the 'pursuit.' * The one or two fragments obtained off St Monans evidently show that the dredge in passing through the sand had come upon the creatures unawares and cut their heads off.

## Additional Notes.

*Lichomolgus agilis*, n. sp.

A species of *Lichomolgus*, apparently new, and of which a description with figures is being prepared for publication by my son, Andrew Scott, and myself, has been found living inside the siphons, and between the branchial folds and the body of the common cockle (*Cardium edule*). My son first discovered the *Lichomolgus* a short time ago, while examining some cockles from Morecambe Bay, Lancashire; more recently we have obtained the same Copepod also in specimens of the common cockle from the neighbourhood of Cramond Island, Firth of Forth. This Copepod agrees with *Lichomolgus litoralis* and one or two others in having the inner branches of the first four pairs of swinging feet all three-jointed, but differs from any species known to us in several important points. It is very active (hence the specific name we have provisionally adopted) and transparent. If a cockle be opened in such a way that a portion of the contained water will remain within the hollow of the opened valves of the shell, specimens of the *Lichomolgus* may be observed darting hither and thither with great rapidity, their presence being in many cases only rendered apparent by the dark coloured line of the alimentary tract. The ovisacs are very large—about half the length of the animal; the

* 'On the Sea Anemones of the Shores of the Cumbraes' (*Proc. Nat. Hist. Soc. of Glasgow*, vol. ii. pp. 24–30).

inner margin of the ovisacs is nearly straight, the outer margin forms a flat but more or less regular curve; they contain numerous, moderately large ova, and, as a considerable number of the Copepods are females, we find, what in such circumstances might be expected, that the species is a comparatively common one,—we have obtained as many as sixteen specimens from a single cockle.

The fact that this *Lichomolgus* has been obtained in cockles from the coast of Lancashire and from the Firth of Forth, and that most of the cockles examined were infested with the Copepod, seems to imply that it is a generally distributed species; if this be so, it may then be of interest to inquire further, whether (*a*) the *Lichomolgus* is found at particular seasons or all the year round, (*b*) as a semi-parasite or as commensal only, (*c*) if its presence has any connection with a healthy or unhealthy condition of the mollusc. Though Copepods, when present in more or less abundance in fresh water, may, in some cases, be rightly considered as 'danger signals,' they are in themselves innoxious, and their presence, though sometimes in considerable numbers, in the cockles, may after all be no indication of hurtful conditions.

*Cyclopicera nigripes*, Brady and Robertson.

This handsome species has only recently been observed within the Forth area. It was obtained by washing a quantity of Zoophytes brought up in the trawl-net while working some miles east of May Island. This is readily distinguished from other species of *Cyclopicera* by its large size and by the dark colour of the foot-jaws and swimming feet. Dr Brady records its occurrence from several places of the North East Coast of England, Shetland (Norman), the Firth of Clyde, and from Lough Swilly, Ireland. I have taken it in Cromarty Firth and in East Loch Tarbert (Loch Fyne).

*Thysanoessa borealis* (G. O. Sars).

This Schizopod has been taken in several parts of the Forth area. I am indebted to Rev. A. M. Norman for the name of the species. He also informs me that among a few Schizopoda sent to him, including the *Thysanoessa*, was what he considers to be a specimen of *Nematocelis megalops* (G. O. Sars.), but it wanted the long slender first pair of legs, which had become detached, and which form one of the chief distinctive characters of the species. The eyes of *Thysanoessa* and *Nematocelis* are distinctly constricted near the middle, so that they appear to consist of an under and upper eye, and this character enables them to be readily distinguished from *Boreophausia* and *Nyctiphanes*.

[DESCRIPTION OF THE PLATES.

## DESCRIPTION OF THE PLATES.

### PLATE VII.

*Stephos minor*, nov. gen. et. sp.

| | | | |
|---|---|---|---|
| Fig. 1. | Female, dorsal view, | magnified 80 | diameters. |
| Fig. 2. | Anterior Antenna, | ,, 130 | ,, |
| Fig. 3. | Posterior Antenna, | ,, 130 | ,, |
| Fig. 4. | Mandible and palp, | ,, 253 | ,, |
| Fig. 5. | Anterior foot-jaw, | ,, 253 | ,, |
| Fig. 6. | Posterior foot-jaw, | ,, 253 | ,, |
| Fig. 7. | Foot of first pair, | ,, 190 | ,, |
| Fig. 8. | Foot of second pair, | ,, 190 | ,, |
| Fig. 9. | Foot of fourth pair, | ,, 190 | ,, |
| Fig. 10. | Fifth pair of feet—female, | ,, 380 | ,, |
| Fig. 11. | Fifth pair of feet—male, | ,, 190 | ,, |
| Fig. 12. | Abdomen of female, | ,, 130 | ,, |
| Fig. 13. | Abdomen of male, | ,, 130 | ,, |

*Acartia bifilosus* (Giesbrecht).

| | | | |
|---|---|---|---|
| Fig. 14. | Foot of fifth pair—female, | magnified 253 | diameters. |

*Pseudocyclopia crassicornis*, nov. gen. et. sp.

| | | | |
|---|---|---|---|
| Fig. 15. | Female, lateral view, | magnified 80 | diameters. |
| Fig. 16. | Anterior antenna, | ,, 380 | ,, |
| Fig. 17. | Posterior antenna, | ,, 190 | ,, |
| Fig. 18. | Mandible, | ,, 253 | ,, |
| Fig. 19. | Mandible palp, | ,, 253 | ,, |
| Fig. 20. | Anterior foot-jaw, | ,, 500 | ,, |
| Fig. 21. | Posterior foot-jaw. | ,, 253 | ,, |
| Fig. 22. | Foot of first pair, | ,, 190 | ,, |
| Fig. 23. | Foot of second pair, | ,, 190 | ,, |
| Fig. 24. | Foot of third pair, | ,, 190 | ,, |
| Fig. 25. | Fifth pair of feet—female, | ,, 380 | ,, |
| Fig. 26. | Fifth pair of feet—male, | ,, 253 | ,, |
| Fig. 27. | Abdomen of female, | ,, 95 | ,, |
| Fig. 28. | Abdomen of male, | ,, 95 | ,, |
| Fig. 29. | Spermatophore, | ,, 190 | ,, |

### PLATE VIII.

*Pseudocyclopia minor*, nov. gen. et. sp.

| | | | |
|---|---|---|---|
| Fig. 1. | Female, lateral view, | magnified 180 | diameters. |
| Fig. 2. | Anterior antenna, | ,, 500 | ,, |
| Fig. 3. | Posterior antenna, | ,, 380 | ,, |
| Fig. 4. | Foot of first pair, | ,, 380 | ,, |
| Fig. 5. | Foot of third pair, | ,, 380 | ,, |
| Fig. 6. | Foot of fourth pair, | ,, 380 | ,, |
| Fig. 7. | Fifth pair of feet—female, | ,, 760 | ,, |
| Fig. 8. | Fifth pair of feet—male, | ,, 380 | ,, |
| Fig. 9. | Abdomen of female, | ,, 190 | ,, |
| Fig. 10. | Abdomen of male, | ,, 190 | ,, |

? *Tetragoniceps maleolata*, Brady.

| | | | |
|---|---|---|---|
| Fig. 11. | Anterior antenna—female, | magnified 253 | diameters. |
| Fig. 12. | Foot of fifth pair—female, | ,, 380 | ,, |

*Cressa dubia* (Spence Bate).

| | | | |
|---|---|---|---|
| Fig. 13. | Mandible and palp, | magnified 253 | diameters. |

*Tachidius crassicornis*, nov. sp.

| | | | | |
|---|---|---|---|---|
| Fig. 14. | Female, lateral view, | magnified | 80 | diameters. |
| Fig. 15. | Male and female—lateral view, | ,, | 80 | ,, |
| Fig. 16. | Anterior antenna—female, | ,, | 380 | ,, |
| Fig. 17. | Anterior antenna—male, | ,, | 380 | ,, |
| Fig. 18. | Posterior antenna, | ,, | 380 | ,, |
| Fig. 19. | Mandible and palp, | ,, | 500 | ,, |
| Fig. 20. | Maxilla, | ,, | 500 | ,, |
| Fig. 21. | Anterior foot-jaw, | ,, | 760 | ,, |
| Fig. 22. | Posterior foot-jaw, | ,, | 500 | ,, |
| Fig. 23. | Foot of first pair, | ,, | 380 | ,, |
| Fig. 24. | Fifth pair of feet—female (minus lateral seta on one side), | | 500 | ,, |
| Fig. 25. | Foot of fifth pair, male, | ,, | 1000 | ,, |
| Fig. 26. | Appendage to first abdominal segment—male, | ,, | 1000 | ,, |
| Fig. 27. | Last abdominal segment and caudal stylets, | ,, | 190 | ,, |

## Plate IX.

*Ameira longicaudata*, nov. sp.

| | | | | |
|---|---|---|---|---|
| Fig. 1. | Female, lateral view, | magnified | 53 | diameters |
| Fig. 2. | Anterior antenna, female, | ,, | 126 | ,, |
| Fig. 3. | Anterior antenna, male, | ,, | 126 | ,, |
| Fig. 4. | Posterior antenna, | ,, | 190 | ,, |
| Fig. 5. | Mandible and palp, | ,, | 380 | ,, |
| Fig. 6. | Maxilla | ,, | 380 | ,, |
| Fig. 7. | Anterior foot-jaw, | ,, | 380 | ,, |
| Fig. 8. | Posterior foot-jaw, | ,, | 400 | ,, |
| Fig. 9. | Foot of first pair, | ,, | 190 | ,, |
| Fig. 10. | Foot of third pair, | ,, | 190 | ,, |
| Fig. 11. | Foot of fourth pair, | ,, | 126 | ,, |
| Fig. 12. | Foot of fifth pair—female, | ,, | 250 | ,, |
| Fig. 13. | Foot of fifth pair—male, | ,, | 250 | ,, |
| Fig. 14. | Appendage of first abdominal segment—male, | ,, | 250 | ,, |
| Fig. 15. | Part of abdomen, and caudal stylets, | ,, | 95 | ,, |
| Fig. 16. | Posterior margin of abdominal segment, | ,, | 380 | ,, |
| Fig. 17. | Female, lateral view—variety, | ,, | 53 | ,, |
| Fig. 18. | One of the abdominal segments—variety, | ,, | 190 | ,, |

*Tetragoniceps bradyi*, nov. sp.

| | | | | |
|---|---|---|---|---|
| Fig. 19. | Female, lateral view, | magnified | 80 | diameters. |
| Fig. 20. | Anterior antenna, | ,, | 250 | ,, |
| Fig. 21. | Posterior antenna, | ,, | 190 | ,, |
| Fig. 22. | Mandible and palp, | ,, | 250 | ,, |
| Fig. 23. | Maxilla, | ,, | 380 | ,, |
| Fig. 24. | ? Mouth, | ,, | 190 | ,, |
| Fig. 25. | Anterior foot-jaw, | ,, | 380 | ,, |
| Fig. 26. | Posterior foot-jaw, | ,, | 380 | ,, |
| Fig. 27. | Foot of first pair, | ,, | 190 | ,, |
| Fig. 28. | Foot of third pair, | ,, | 190 | ,, |
| Fig. 29. | Foot of fourth pair, | ,, | 190 | ,, |
| Fig. 30. | Foot of fifth pair, | ,, | 190 | ,, |
| Fig. 31. | Abdomen and caudal stylets | ,, | 90 | ,, |
| Fig. 32. | One of the caudal stylets | ,, | 250 | ,, |

## Plate X.

? *Lichomolgus littoralis*, nov. sp. ♂

| | | | | |
|---|---|---|---|---|
| Fig. 1. | Anterior antenna, | magnified | 126 | diameters. |
| Fig. 2. | Posterior antenna, | ,, | 126 | ,, |
| Fig. 3. | Mandible, | ,, | 190 | ,, |
| Fig. 4. | Maxilla. 4 *a*. Anterior foot-jaw, | ,, | 190 | ,, |
| Fig. 5. | Posterior foot-jaw, | ,, | 190 | ,, |
| Fig. 6. | Foot of first pair (inner branch minus last joint), | ,, | 126 | ,, |
| Fig. 7. | Foot of fourth pair, | ,, | 126 | ,, |
| Fig. 8. | Foot of fifth pair, | ,, | 280 | ,, |
| Fig. 9. | Abdomen and caudal stylets | ,, | 190 | ,, |

*Cletodes lata*, nov. sp. ♀

| | | | |
|---|---|---|---|
| Fig. 10. | Female, dorsal view, | magnified 80 | diameters. |
| Fig. 11. | Anterior antenna, | ,, 380 | ,, |
| Fig. 12. | Posterior antenna, | ,, 500 | ,, |
| Fig. 13. | Mandible and palp, | ,, 760 | ,, |
| Fig. 14. | Posterior foot-jaw, | ,, 500 | ,, |
| Fig. 15. | Foot of first pair, | ,, 380 | ,, |
| Fig. 16. | Foot of third pair, | ,, 380 | ,, |
| Fig. 17. | Foot of fifth pair, | ,, 250 | ,, |
| Fig. 18. | Foot of fifth pair—variety, | ,, 250 | ,, |

*Tetragoniceps macronyx*, nov. sp.

| | | | |
|---|---|---|---|
| Fig. 19. | Female, lateral view, | magnified 160 | diameters. |
| Fig. 20. | Anterior antenna—female, | ,, 250 | ,, |
| Fig. 21. | Anterior antenna—male, | ,, 250 | ,, |
| Fig. 22. | Posterior antenna, | ,, 760 | ,, |
| Fig. 23. | Anterior foot-jaw, | ,, 500 | ,, |
| Fig. 24. | Posterior foot-jaw, | ,, 250 | ,, |
| Fig. 25. | Foot of first pair, | ,, 380 | ,, |
| Fig. 26. | Foot of fourth pair, | ,, 190 | ,, |
| Fig. 27. | Foot of fifth pair—female, | ,, 500 | ,, |
| Fig. 28. | Foot of fifth pair—male, | ,, 500 | ,, |

## Plate XI.

*Laophonte inopinata*, nov. sp.

| | | | |
|---|---|---|---|
| Fig. 1. | Female, lateral view, | magnified 160 | diameters. |
| Fig. 2. | Male, dorsal view, | ,, 160 | ,, |
| Fig. 3. | Anterior antenna—female, | ,, 500 | ,, |
| Fig. 4. | Anterior antenna—male, | ,, 500 | ,, |
| Fig. 5. | Posterior antenna, | ,, 500 | ,, |
| Fig. 6. | Anterior foot-jaw, | ,, 500 | ,, |
| Fig. 7. | Posterior foot-jaw, | ,, 500 | ,, |
| Fig. 8. | Foot of first pair, | ,, 380 | ,, |
| Fig. 9. | Foot of third pair, | ,, 500 | ,, |
| Fig. 10. | Foot of fifth pair | ,, 380 | ,, |
| Fig. 11. | One of the caudal stylets | ,, 250 | ,, |
| Fig, 12. | One of the body segments, | ,, 500 | ,, |

*Thalestris harpactoides*, Claus.

| | | | |
|---|---|---|---|
| Fig. 13. | Posterior foot-jaw, | magnified 250 | diameters. |
| Fig. 14. | Foot of first pair, | ,, 190 | ,, |
| Fig. 15. | Foot of second pair—male, | ,, 190 | ,, |
| Fig. 16. | Foot of fifth pair—male, | ,, 125 | ,, |

*Cylindropsyllus minor*, nov. sp.

| | | | |
|---|---|---|---|
| Fig. 17. | Female, dorsal view, | magnified 80 | diameters. |
| Fig. 18. | Anterior antenna, | ,, 250 | ,, |
| Fig. 19. | Posterior foot-jaw, | ,, 760 | ,, |
| Fig. 20. | Foot of first pair, | ,, 380 | ,, |
| Fig. 21. | Foot of second pair, | ,, 380 | ,, |
| Fig. 22. | Foot of third pair, | ,, 380 | ,, |
| Fig. 23. | Foot of fourth pair, | ,, 380 | ,, |
| Fig. 24. | Foot of fifth pair, | ,, 190 | ,, |

*Lichomolgus concinnus*, nov. sp.

| | | | | |
|---|---|---|---|---|
| Fig. 25. | Female, dorsal view, | magnified | 60 | diameters. |
| Fig. 26. | Anterior antenna, | ,, | 190 | ,, |
| Fig. 27. | Posterior antenna, | ,, | 190 | ,, |
| Fig. 28. | Anterior foot-jaw | ,, | 500 | ,, |
| Fig. 29. | Posterior foot-jaw, | ,, | 500 | ,, |
| Fig. 30. | Foot of first pair, | ,, | 125 | ,, |
| Fig. 31. | Foot of fourth pair, | ,, | 125 | ,, |
| Fig. 32. | Foot of fifth pair, | ,, | 500 | ,, |
| Fig. 33. | Abdomen and caudal stylets, | ,, | 195 | ,, |

## Plate XII.

*Tetragoniceps incertus*, nov. sp.

| | | | | |
|---|---|---|---|---|
| Fig. 1. | Female, lateral view, | magnified | 80 | diameters. |
| Fig. 2. | Male, dorsal view, | ,, | 80 | ,, |
| Fig. 3. | Anterior antenna, female, | ,, | 250 | ,, |
| Fig. 4. | Anterior antenna, male, | ,, | 250 | ,, |
| Fig. 5. | Posterior antenna, | ,, | 760 | ,, |
| Fig. 6. | Mandible and palp, | ,, | 380 | ,, |
| Fig. 7. | Maxilla, | ,, | 380 | ,, |
| Fig. 8. | Anterior foot-jaw | ,, | 500 | ,, |
| Fig. 9. | Posterior foot-jaw, | , | 500 | ,, |
| Fig. 10. | Foot of first pair, | ,, | 380 | ,, |
| Fig. 11. | Foot of second pair—female, | ,, | 380 | ,, |
| Fig. 12. | Foot of second pair—male, | ,, | 380 | ,, |
| Fig. 13. | Foot of third pair—female, | ,, | 380 | ,, |
| Fig. 14. | Foot of third pair—male, | ,, | 380 | ,, |
| Fig. 15. | Foot of fourth pair, | ,, | 380 | ,, |
| Fig. 16. | Fifth pair of feet—female, | ,, | 380 | ,, |
| Fig. 17. | Foot of fifth pair—male, | ,, | 380 | ,, |

*Paramesochra dubia.*

| | | | | |
|---|---|---|---|---|
| Fig. 18. | Female, dorsal view, | magnified | 125 | diameters. |
| Fig. 19. | Male, dorsal view, | ,, | 125 | ,, |
| Fig. 20. | Anterior antenna, female, | ,, | 500 | ,, |
| Fig. 21. | Anterior antenna, male, | ,, | 500 | ,, |
| Fig. 22. | Posterior antenna, | ,, | 760 | ,, |
| Fig. 23. | Mandible, | ,, | 760 | ,, |
| Fig. 24. | Mandible palp, | ,, | 760 | ,, |
| Fig. 25. | Maxilla, | ,, | 500 | ,, |
| Fig. 26. | Anterior foot-jaw, | ,, | 760 | ,, |
| Fig. 27. | Posterior foot-jaw, | ,, | 760 | ,, |
| Fig. 28. | Foot of first pair, | ,, | 500 | ,, |
| Fig. 29. | Foot of second pair, | ,, | 500 | ,, |
| Fig. 30. | Foot of fourth pair, | ,, | 500 | ,, |
| Fig. 31. | Foot of fifth pair—female, | ,, | 500 | ,, |
| Fig. 32. | Foot of fifth pair—male, | ,, | 500 | ,, |

## Plate XIII.

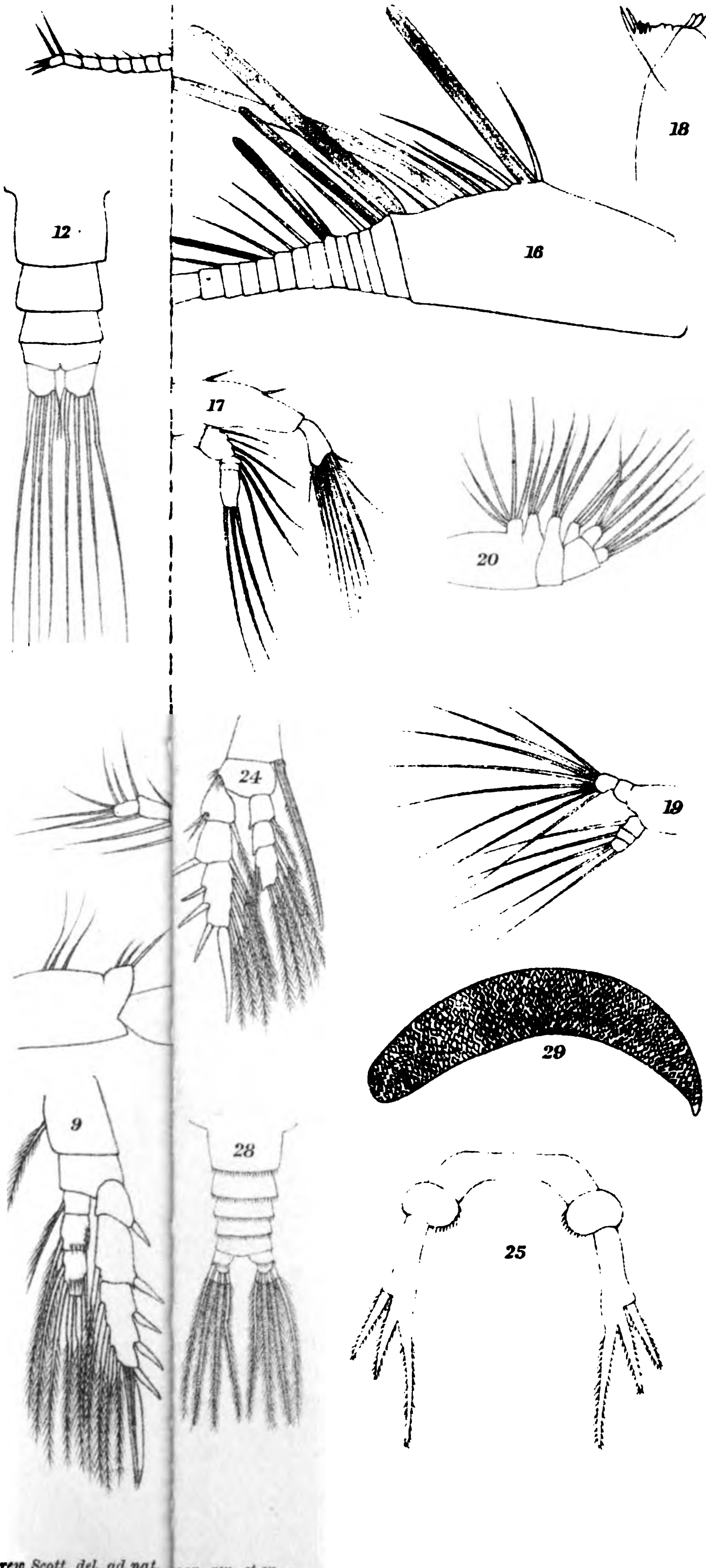
*Cylindropsyllus lævis*, Brady.

| | | | | |
|---|---|---|---|---|
| Fig. 1. | Female, lateral view, | magnified | 80 | diameters. |
| Fig. 2. | Male, lateral view, | ,, | 80 | ,, |
| Fig. 3. | Anterior antenna—female, | ,, | 250 | ,, |
| Fig. 4. | Anterior antenna—male, | ,, | 250 | ,, |
| Fig. 5. | Posterior antenna, | ,, | 250 | ,, |
| Fig. 6. | Mandible and palp, | ,, | 500 | ,, |
| Fig. 7. | ? Maxillæ and mouth, | ,, | 500 | ,, |
| Fig. 8. | ? Rabium, | ,, | 500 | ,, |
| Fig. 9. | Anterior foot-jaw, side view, | ,, | 760 | ,, |
| Fig. 10. | ,, ,, front view, | ,, | 570 | ,, |
| Fig. 11. | Posterior foot-jaw, | ,, | 500 | ,, |

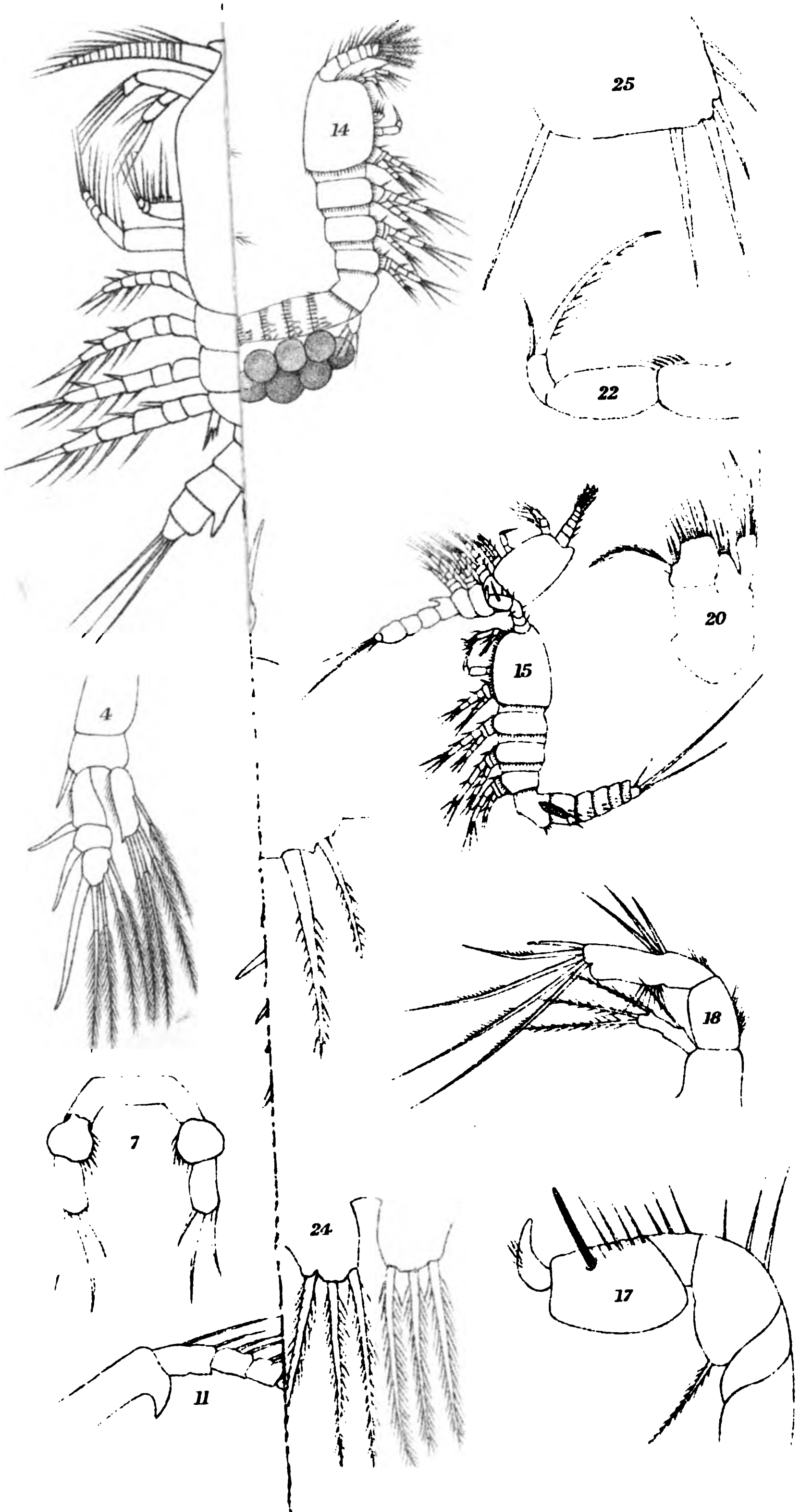
| | | | | |
|---|---|---|---|---|
| Fig. 12. | Foot of first pair, | magnified | 250 | diameters. |
| Fig. 13. | Foot of second pair—male, | ,, | 250 | ,, |
| Fig. 14. | Foot of third pair—male, | ,, | 250 | ,, |
| Fig. 15. | Foot of fifth pair—female, | ,, | 500 | ,, |
| Fig. 16. | Foot of fifth pair—male, | ,, | 380 | ,, |
| Fig. 17. | Appendage of first abdominal segment—male, | ,, | 380 | ,, |
| Fig. 18. | Structure of carapace, highly magnified. | | | |

*Neobradya pectinifer*, nov. gen. et. sp.

| | | | | |
|---|---|---|---|---|
| Fig. 19. | Male, dorsal view, | magnified | 53 | diameters. |
| Fig. 20. | Female, lateral view, | ,, | 53 | ,, |
| Fig. 21. | Anterior antenna—female, | ,, | 190 | ,, |
| Fig. 22. | Anterior antenna—male, | ,, | 190 | ,, |
| Fig. 23. | Posterior antenna, | ,, | 380 | ,, |
| Fig. 24. | Mandible and palp, | ,, | 190 | ,, |
| Fig. 25. | Maxilla, | ,, | 340 | ,, |
| Fig. 26. | Anterior foot-jaw, | ,, | 340 | ,, |
| Fig. 27. | Posterior foot-jaw, | ,, | 510 | ,, |
| Fig. 28. | Foot of first pair, | ,, | 225 | ,, |
| Fig. 29. | Foot of second pair, | ,, | 225 | ,, |
| Fig. 30. | Foot of fourth pair, | ,, | 225 | ,, |
| Fig. 31. | Foot of fifth pair—female, | ,, | 340 | ,, |
| Fig. 32. | Foot of fifth pair—male, | ,, | 340 | ,, |



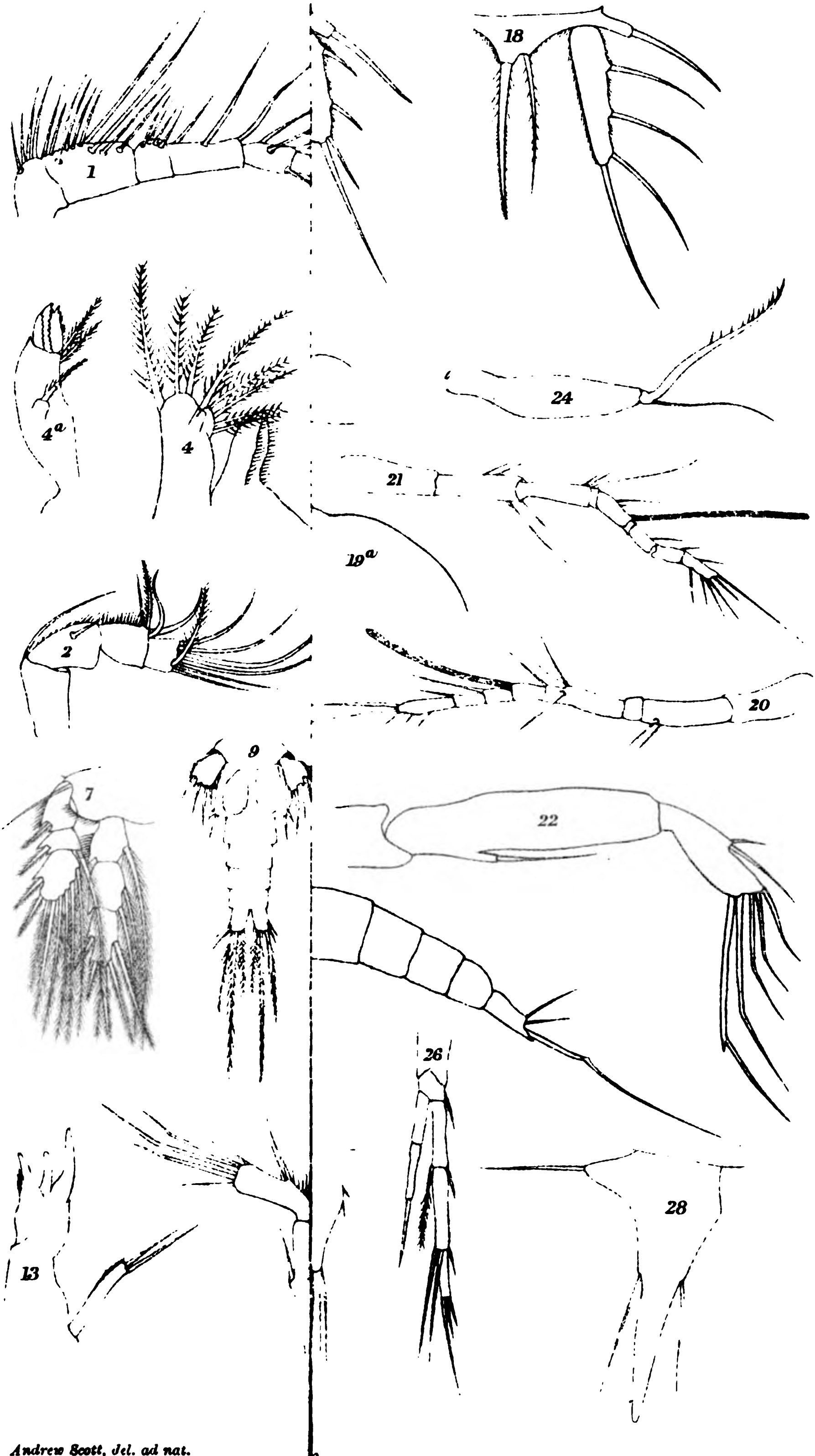

*Andrew Scott, del. ad nat.* *nov. gen. et sp.*



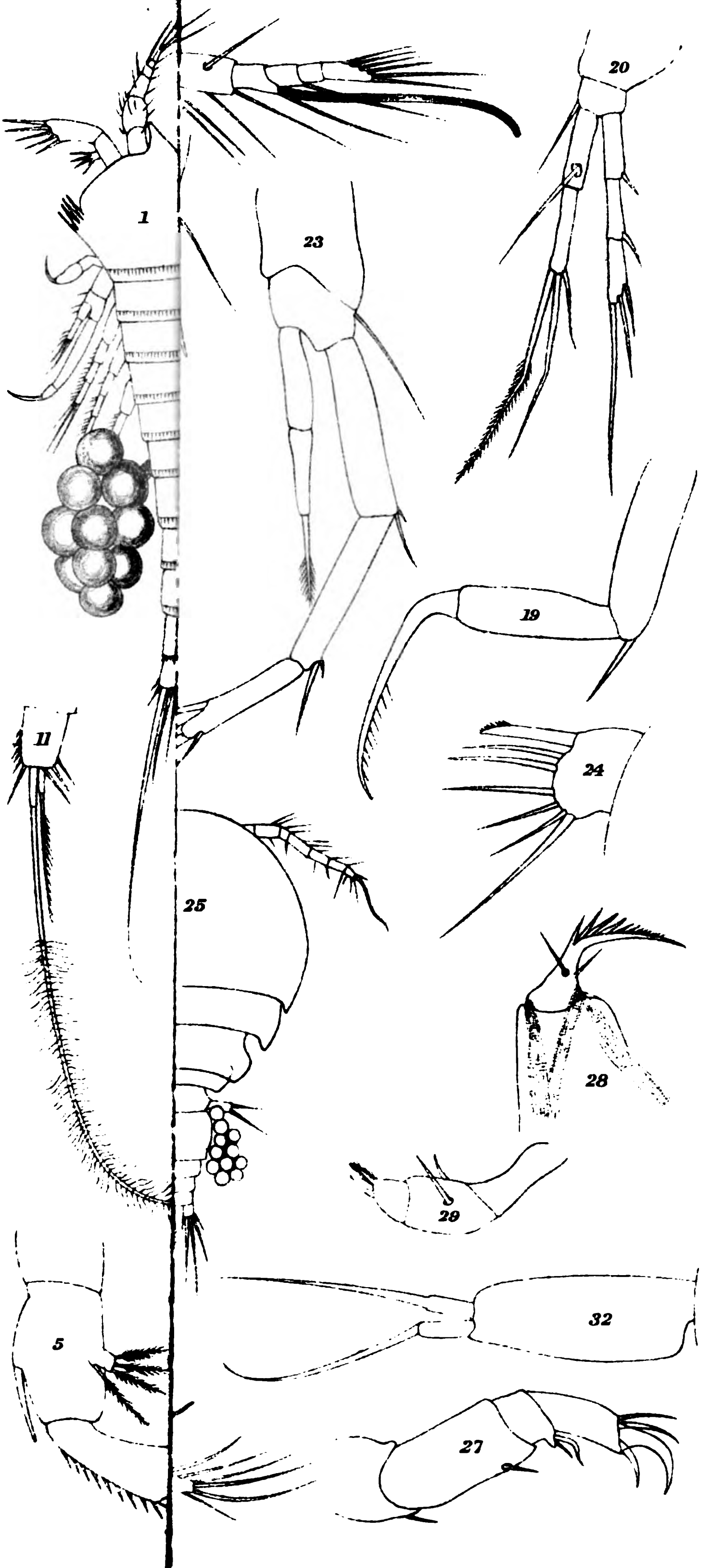

*Andrew Scott, del. ad nat.* ...idius crassicornis, nov. sp.

PLATE IX.

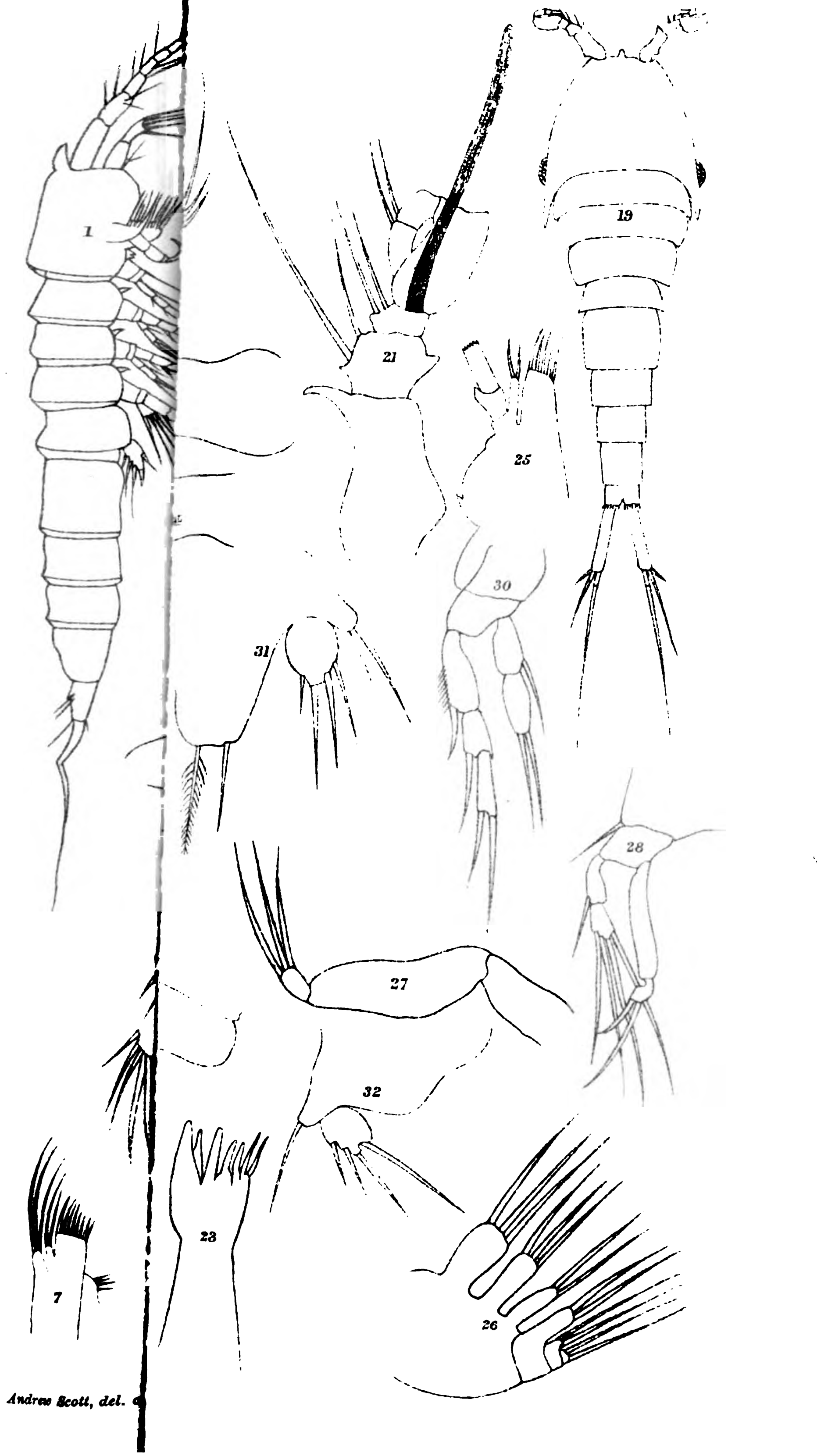

Andrew Scott, del. ad nat.




Andrew Scott, del. ad nat.

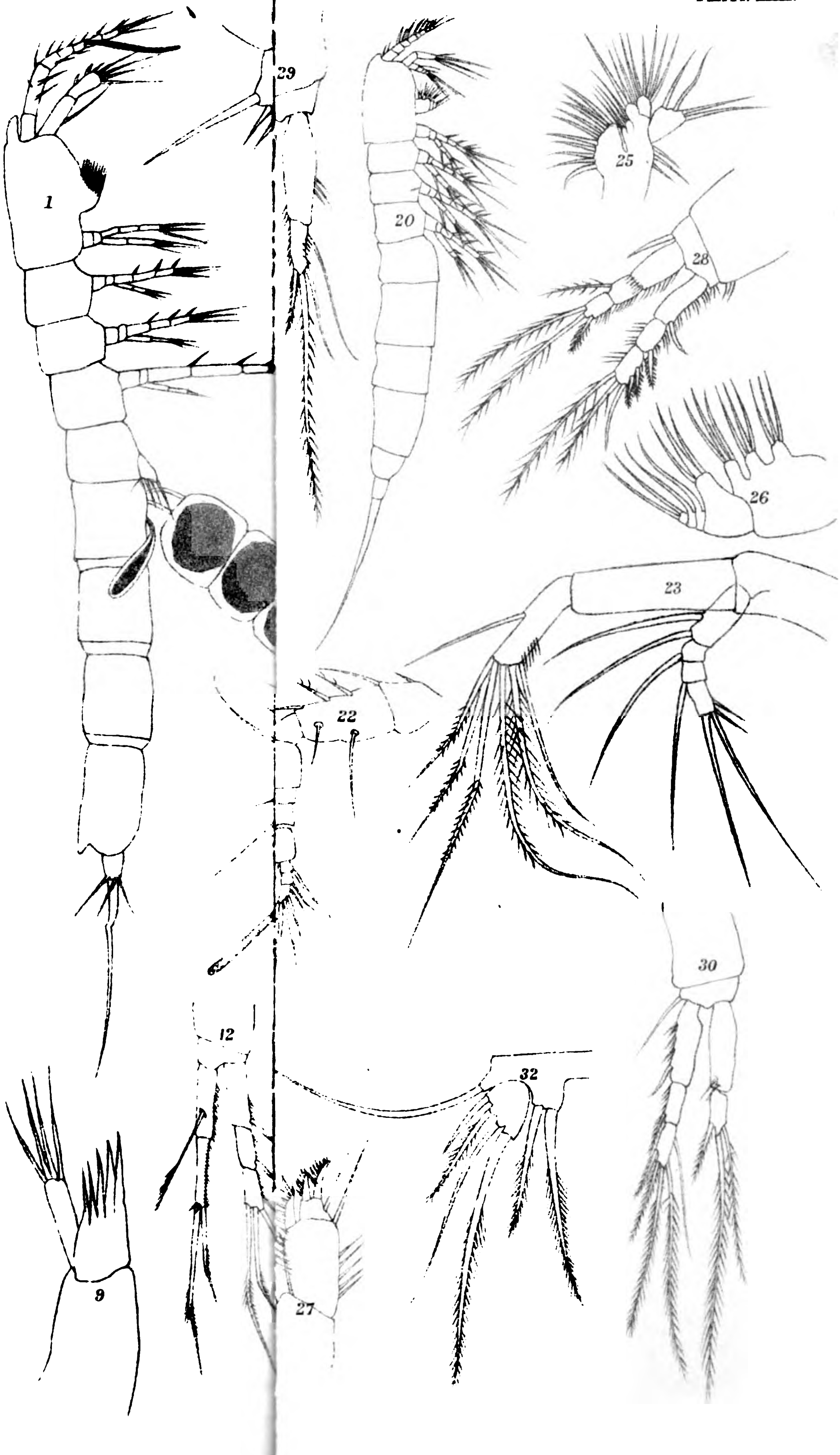



Andrew Scott, del. anolgus concinnus, nov. sp.




Andrew Scott, del.

PLATE XIII.




Andrew Scott, del. ad nat.

## IV.—CONTRIBUTIONS TO THE LIFE-HISTORIES AND DEVELOPMENT OF THE FOOD AND OTHER FISHES. By Professor M'Intosh, M.D., LL.D., F.R.S., F.R.S.E., St Andrews Marine Laboratory. (Plates XIV.–XVII.)

CONTENTS.



### 1. General Remarks.

At present the observer in this country has laboriously to search the seas for his specimens of the earlier conditions of the food-fishes, finding a stage here and another there; and the whole task of identifying young forms, which closely simulate each other at this period, and whose rate of growth is irregular, is thrown upon him. Under these circumstances progress is somewhat slow, and misinterpretations not uncommon. Yet all this might have been avoided if the appeal for a few inexpensive open-air tanks (where they can best be supervised) had been granted. Then the ova would have been placed under nearly natural conditions, and the history of the several species of food-fishes rapidly and accurately followed. Yet, perhaps, the satisfaction derived from the occasional appearance of important links—even though they occur only at long intervals—does much to solace the observer under existing circumstances.

The present season has been productive of several interesting additions to our knowledge of the pelagic eggs of the food-fishes, a result in a large measure due to the sympathy and energy of the Scientific Secretary of the Board, who has spared no effort to fill in the gaps in this department. The list of the eggs of British food-fishes which have been developed has thus been extended; those which for the first time have been fully described, figured and hatched at St Andrews (and by that expression is meant in this country) are, in the case of pelagic eggs, the following species:—frog-fish, grey-gurnard, dragonet, cod, haddock, whiting, poor-cod, ling, torsk, long-rough dab, turbot (partly), brill, sail-fluke, plaice, lemon-dab, flounder, sole, dab and sprat, while not a few others have been examined and figured for the first time, or additional information about them gained, such as the pelagic eggs of the lesser weever, bib, green cod, pollack, rockling, halibut, Müller's topknot, solenette, craig-fluke, mackerel, &c., besides various undetermined eggs and larva.

Of non-pelagic or demersal eggs those for the first time accurately described and figured are :—short-spined *Cottus*, long-spined *Cottus*, armed bull-head, lump-sucker, Montagu's sucker, wolf-fish; shanny (ovarian eggs), gunnel, sand-eel, and sand-launce. Other forms specially dealt with in this group are goby, sea-bream, bimaculated sucker, viviparous blenny, fifteen-spined stickleback, three-spined stickleback, salmon, herring, and myxine, while the ovarian eggs of many others, such as the eel, conger, Yarrell's blenny, &c., have also been under observation.

## 2. Remarks on Young Pleuronectids.

In the *Researches* * it was mentioned that a small egg (F), with a single oil-globule, and from ·034 to ·036 inch long, was captured by the trawl-like tow-net, at the bottom, in the early part of May,† and for some time thereafter. It was figured in Pl. V. fig. 4, the embryo being well advanced. The character of the pigment and the reticulated appearance of the embryo were distinctive. The larval form, after extrusion, was also figured (Pl. XVII. fig. 1); it measured a tenth of an inch, and had yellowish pigment along the marginal fin dorsally and ventrally, with blackish chromatophores. The general surface of the body, the head and yolk-sac, are dotted with yellowish pigment, and a few black chromatophores are present in the yolk and under the oil-globule. No pigment appears in the eyes. The oil-globule is situated inferiorly, distinctly behind the middle of the yolk-sac, while a considerable interval exists between it and the posterior border of the latter. Moreover, the entire surface of the larval fish is covered with a somewhat coarse reticulation of cells with nuclei, which do not occur at the centre of the cells, but at their margins. On the third day the distribution of the pigment was more general, but the mouth had not yet opened.

The larval fish was kept till the yolk and oil-globule had disappeared. The chief change was the more conspicuous nature of the yellowish chromatophores along the margin of the dorsal fin. The head also assumed a deeper yellow hue from the pigment over the brain, and the body is covered with many minute yellow chromatophores mingled with black. The pectorals are tipped with yellow, and have the streaked mesoblastic basal region. The eyes are greenish-silvery. The mouth is now widely open. It was then remarked that at this stage it resembled a Pleuronectid.

The same egg was alluded to last year ‡ as occurring in May and June, and by no means uncommon in the bottom tow-nets. It was observed that the oil-globule is comparatively small (about ·1524 mm., or a little more), somewhat like that of the topknot,§ that the vent occurs a short distance behind the yolk-sac, and that the egg and larva probably pertain to a fish by no means infrequent in the neighbourhood. The occurrence of many examples last summer, after the publication of the foregoing remarks, both at surface and bottom, and a more careful consideration of its relationships, enabled us to come to the conclusion that it closely approached the egg of the turbot, though differing in certain details.

Moreover, Dr Fulton most courteously forwarded at various times portions of the ovaries of the turbot, so that eggs more or less ripe could be contrasted with the foregoing; and further, many fine specimens of turbot from Iceland and other northern parts were examined somewhat later on the Pontoon at Grimsby. The ovarian egg of the turbot, approaching maturity (Pl. XIV. fig. 1), was thus obtained, the centre of the

* *Trans. Roy. Soc. Edin.*, vol. xxxiii. part 3, Feb. 1890.

† This year, for instance, the first egg with embryo fully half round the yolk was procured in the bottom net of the 'Garland' in St Andrews Bay on 30th April.

‡ *Ninth Ann. Report*, p. 321, pl. xlii. figs. 4 and 5, 1891.

§ *Op. cit.*, vol. xxxiii., p. 852, Pl. i. fig. 6. The larger size of this egg alone prevented our associating it with the specimens referred to (F). It may have been softened.

egg being filled with yolk-spheres,—that is, before the final change to the translucent pelagic condition had taken place. As a result of these observations it would appear that the turbot spawns off the East Coast sparingly at the end of April and in May, and more abundantly in June and July. Few of the turbot from Iceland were very ripe towards the end of June, though many had a few translucent eggs here and there. All observations up to date seem to show that the spawning season of a given species is earlier in the south, and gets later as we proceed northward. The spawning-period just mentioned would appear to coincide with the occurrence in deep water of the unknown post-larval forms, hereafter to be described, but such post-larval and young forms are occasionally to be found near shore, as in the neighbourhood of the 'Traith' or Turbot-Hole in the Forth.

It is interesting that the majority of the ova captured by the tow-nets in St Andrews Bay had embryos far advanced, apparently indicating that they had been carried by currents a considerable distance, a supposition perhaps borne out by the actual distribution of the adults (*i.e.*, mature fishes) in the neighbourhood.

An egg (of the doubtful form F) at an early stage of advancement (9th July 1891) is shown in Pl. XIV. fig. 2, the blastoderm having spread out as it proceeds to envelop the yolk. The perivitelline space is small, and sometimes the exterior of the zona is slightly roughened from adherent particles. In one somewhat older, fig. 3, 8th July 1891, a peculiar constriction is observed, as if the blastoderm were compressing the yolk before the closure of the blastopore, but the latter is already closed. On focussing deeply, several vesicles and granules (*a*) are visible. Next day (9th) a slightly yellowish tinge is visible over the embryo and yolk, and the latter presents minute granules with processes, the precursors of the pigment-specks. The lenses are distinct, and the caudal end of the embryo projects (Pl. XIV. fig. 4) with several large vesicles (Kupffer's) in front of it. Protoplasmic processes stretch from the pectoral region. On the 12th the heart pulsated actively (60 per minute), though the impression in regard to certain ova was that the action of the heart was somewhat later in being manifested than in the cod. The reticulated papillose condition of the surface of the yolk is also visible. Active movements of the embryo take place, and it rolls and twists in the egg. After the appearance of the otoliths the cuticular surface over the eye shows the same papillose condition as that characteristic of the yolk, and the embryo constantly changes its position (Pl. XIV fig. 6). The site of the oil-globule in a lateral view of the egg at a somewhat earlier stage is shown in fig. 5. At the former stage (fig. 6) the hind-gut is distinct, but the anus is closed. The ring of protoplasm around the fixed oil-globule is well marked, and the yolk is considerably less. These ova are not quite round, one diameter often exceeding the other, so that they appear slightly ovoid.

The larva has already been described in the *Researches* (p. 835), and it is only necessary to note certain features. The pigment is deep gamboge yellow, and a patch occurs about the middle of the tail. The same yellowish pigment suffuses the snout, eyes, and sides of the body, but does not at first go into the marginal fin. It, however, tints the under surface of the head and the upper part of the yolk-sac. A few black chromatophores accompany the yellow. By transmitted light the pigment is very deep, almost approaching orange. The pectoral is small. Traces of two slight folds of skin are occasionally seen from the oil-globule forward on each side of the yolk. The notochord seems to be multicolumnar. Professor Prince's figure (*Researches*, pl. xvii. fig. 4) is evidently from a larva much better matured before hatching. In a paper recently (Dec. 1891) communicated to the Royal Dublin Society,

and which I had the privilege of perusing, Mr E. W. L. Holt has pointed out that the unknown egg (F), with the oil-globule and its larval and post-larval stages, described in the *Researches*, though approaching the egg and young of the turbot, yet presented certain differences. This conclusion, as already stated, had been held at St Andrews, at first mainly by the fact that the pelagic egg of every other common pleuronectid had been determined, that an egg occurring not unfrequently throughout the season must belong to a form well known in the neighbourhood, and subsequently by the appearance of the egg in the ripe turbot. It is true the ripe ova of a turbot of 12 lbs. were seen during the trawling expeditions of 1884 (10th July), but in the midst of many duties in the open sea, all that could be done then was to see that they were pelagic, and consign them to spirit, especially as no male could be procured for fertilisation.* It was observed that the eggs were small, only a little larger than those of the rockling, and the embryos, many of which were hatched from pelagic ova of the same appearance, captured by the tow-net on the spot, were likewise small.

Mr Holt found that at St Andrews the eggs termed F, in July and August had a diameter of ·82, and that of the oil-globule, ·11 mm. A single egg obtained in Valencia harbour on the 27th March measured ·75 mm., the diameter of the oil-globule being ·15 mm. Moreover, he hatched this egg, and found that the larva agreed with species F, figured in the *Researches*. He points out, however, that in his larval fish the anus did not at first reach the edge of the marginal fin, but this condition was not noticed by Professor Prince or myself, though it may readily have been overlooked. Mr Holt gives the length of the larva as 2·51 mm. 'From the snout to the imperforate anus is 1· mm., and an interval of '·11 mm. separates the latter from the hinder margin of the yolk. The 'notochord is multicolumnar.' When two days old 'the total length is '3·57 mm., of which the preanal region occupies 1·37 mm. An interval 'of ·21 mm. separates the anus (now marginal) from a perpendicular from 'the hind margin of the yolk. A great increase has taken place in 'the breadth and extent of the marginal fin,' so that the larva now has the characteristic appearance of a pleuronectid. 'The separation of the 'rectum and yolk appears to indicate a relationship to a sinistral rather 'than a dextral form (*cf.* Agassiz and Whitman, *Rhomboidichthys*, and 'Raffaele, *Rhombus levis*).' On the other hand, he finds that the ripe unfertilized ova of the turbot vary from ·99 to 1·06 mm., and the oil-globule from ·20 to ·21 mm.

In the *Researches*, at p. 846, a post-larval form, not uncommon in deep water, is described, and the suggestion that this sinistral pleuronectid may be the turbot was thrown out. As, however, no continuous series from these up to the undoubted young turbot has been obtained, considerable dubiety remains, indeed, from the progress made by the right eye, it would seem to pertain to a smaller fish than the turbot, possibly the topknot, an opinion shared by Mr Holt. It is a remarkable fact, indeed, that up to this period the life-history of so important a fish as the turbot should present so many blanks. The same forms were obtained in considerable numbers by Mr Holt during his recent work off the west coast of Ireland, and he has been enabled to give reliable drawings from life, and thus record more accurately their form and coloration. Little, however, can be added to the description of these early forms up to 9 mm. Mr Holt likewise could make out no spines on the otocystic region, such being present in the young of another young form apparently connected with the brill. In Pl. XIV. fig. 7, the early post-larval stage of this sinistral pleuronectid is figured, unfortunately, from a somewhat softened spirit-preparation, and

* By treating these eggs with spirit, acetic acid and camphor, the oil-globule is easily observed.

it is younger than that described on p. 845 of the *Researches*, both, however, being procured at the same time, viz., 30th August 1886. It measures 4·5 mm. in spirit. The embryonic tail is still conspicuous, but the caudal rays are developing rapidly beneath it. On the 10th July 1890 a somewhat older stage was captured in the bottom-net in St Andrews Bay, and is figured in the fresh (not living) condition in Pl. XIV. fig. 8. Mr Holt, who has examined the figure, recognises it as the form he met with on the west coast of Ireland, and it appears to correspond with those got in former years in deep water off the east coast of Scotland. The dark pigment, as Mr Holt points out, is confined to the posterior region of the body.

The descriptions of the various subsequent stages need not be repeated, but a figure (Pl. XIV. fig. 10) of the young fish with the right eye touching the ridge is necessary for continuity. At this stage it measures in spirit about 5 mm., those at 6 mm. presenting little change. The caudal has now attained larger proportions.

Mr Holt, in describing a specimen 6 mm. in length, mentions that he believed that 'in life a profuse pale yellow pigmentation was present every- 'where but on the marginal fins,' though he adds the caution that he had only his memory to rely on at this stage. In older specimens he had no doubt. No separate chromatophores could be seen, 'so that the yellow 'tint may have been due to a coloration of the tissues, though I do not 'think this was the case.' 'Whilst the commencement of the post-anal 'region is little pigmented, the middle is profusely speckled, both on body 'and marginal fins, with minute stellate chromatophores. A few rounded 'chromatophores occur also on the anterior parts of the dorsal and ventral 'fins, and about the sides of the body. The eyes are black, and there is 'a little pigment on the top of the hind-brain, and between that structure 'and the notochord.' Chromatophores also occur on the jaws, ventral line, renal region, and other parts. At 9·5 mm. (Pl. XIV. fig. 11) the right eye is on the ridge, and the embryonic tail is much diminished; moreover, the pelvic fins are visible as minute processes inferiorly. Careful examination of the otocysts of such an example show only a very slight thickening at two points, viz., superiorly over the canals, and inferiorly over the otoliths. No spines are visible. Such a form, therefore, differs materially from the brill-like post-larval pleuronectid.

In two specimens of this stage procured by the 'Garland' on Smith Bank, off Caithness, 28th June 1889, the right or future under-surface is (in spirit) minutely flecked all over with black points, while the right presents only a trace of such, chiefly posteriorly. A median black line occurs on the oblique region of the abdomen, behind the pelvic fins, which are also speckled with black pigment-touches. They measured 10·5 and 11 mm.,—the rays in the former being D. 89, A. 64, and in the other D. 79 and A. 57 — such approaching the condition in the topknot (*Zeugopterus punctatus*).

The foregoing stages were procured in considerable numbers during two seasons, by the courtesy of the Fishery Board, in the 'Garland,' viz., about 15 miles S.E. of the Island of May, on August 30, 1886, with the large midwater net at 25 fathoms, in water 32 fathoms deep; and again, on the 21st July 1887, St Abb's Head bearing about 14 miles S.S.W., with the midwater net at 27 fathoms, in water 32 fathoms deep. All were characteristically 'buff' coloured, with the tip of the snout yellowish, while both sides were minutely speckled with black points. In those with the eyes on the left, indications of five or six dark bands occur on the dorsal and anal fins, and the eyes have dark pigment. These delicate forms generally cling to the meshes of the net, as if they had been compressed and killed by the currents, just as the larger and stronger young salmon are against the perforated zinc of the sluices at Stormontfield.

If the rays of the dorsal and anal fins of these specimens be examined, the following approximative results are obtained: *—

| Total length. | Dorsal. | Anal. |
|---|---|---|
| 6·5 mm. | 65 | 60 |
| 6·5† " | 64 | 62 |
| 7 " | 64 ? | 52 ? (injured) |
| 7·5 " | 83 | 63 |
| 8 " | 88 | 46 ? (injured) |
| 8·5 " | 77 | 67 |
| 9 " | 63 | 52 |
| 9 " | 76 | 42 ? (injured) |
| 9 " | 82 | 66 |
| 9·5 " | 83 | 61 |
| 11 " | 64 | 52 |

The diversities in the number of rays in such examples would lead to the supposition either that the young of several forms (other than turbot and brill) were included in the list, or that considerable changes ensue during growth. So far as experience of other Teleosteans goes, there is nothing unusual in the congregation of the post-larval and young forms allied to the turbot and brill; and, moreover, the close resemblances which such fishes may show in their early condition has a parallel in the case of the cod, haddock, and whiting, but especially the two former. On the other hand, it has formerly been pointed out ‡ that, in regard to the wolf-fish (*Anarrhichas*), remarkably little variation occurs between the osseous rays of the young form and those of the adult, 71 being present in the dorsal of the young, measuring about ¾ inch, and the same number in the adult, about 3 feet in length.

Further, the uncertainty of the species we are dealing with must be borne in mind. As the younger forms show fewer rays, it is possible also that additions may occur to these in the earlier stages, both anteriorly and posteriorly.

In the examples forwarded by Mr Holt from the coast of Donegal, and procured in May 1891, in deep water (29 faths., &c.), the larger (about 8·5 mm.) had D. 63, A. 57. Mr Holt, however, explains in a letter that the discrepancy between the rays of such examples and those of the adult turbot and brill with which they were for the moment compared, is somewhat greater than in other pleuronectids, since the dorsal often showed 80 + and the anal 60 +. In regard to this divergence in the number of rays, he indeed raises the question whether his young forms (buff-coloured) may not belong to one of the topknots, viz., *Zeugopterus punctatus*, *Z. norvegicus*, and *Z. unimaculatus*. No continuous series of the subsequent stages having been observed, the species to which these forms must be relegated is at present in uncertainty.

Turning now to the turbot, it is found that the earlier stages are involved in considerable obscurity, especially those under 12 mm. In these stages it either takes to the ground in deep water and remains there, or, having gone downward, afterwards seeks the shallows inshore. So far as my experience goes, the subsequent stages have been procured in the tow-nets inshore, in trawls in the same region, by the hand-net at the margin of the tide on sandy beaches, or by the seine or other net on the same shores. Of course it is possible that some remain on the ground (in deep water) on which they were when the metamorphosis occurred, while the young from the pelagic eggs—swept inshore by the currents—simply developed where they were carried. It is, at any rate, a fact that

* I am indebted to my assistant, Mr W. E. Collinge, for carefully calculating these and other fin-rays.

† Mr Holt gives in the case of one 6·6 mm. 70 rays in the dorsal and 65 in the anal.

‡ *Researches*, p. 892.

young turbot, from 1 up to 5 inches, are abundant near the tidal margin on sandy beaches; that the older forms, from 5 to 11 inches, are plentiful in somewhat deeper water in sandy bays, such as that of St Andrews; while the mature adults are met with only in the deeper water, in general beyond the three-mile limit. It is interesting to note the independent remarks of Mr Holt on this subject. They came into my hands after the foregoing was written. He writes*—'This table, so far as it goes, ap-'pears to show that no mature turbot penetrate into quite such shallow 'water as some of the immature forms, and also that no immature forms 'get into such deep water as a proportion of the mature. It would also 'appear that the closing of waters within the 10-fathom line would pro-'tect a very large proportion of the immature forms, though, at the same 'time, in the case of such places as Loch Swilly, a large number of fine 'fish might be prevented from reaching the market. Fulton is of opinion 'that on the East Coast the majority of the young turbot are on the off-'shore grounds. It seems to me that the evidence is all to the contrary. 'Fulton finds a difficulty in accepting the statement that "thousands of '"young turbot may be found at some places in the shallow waters and '"pools on the beach, and that they are largely destroyed by shrimp-'"fishers."

'I have myself taken turbot about 2 inches long at the sandy margin, 'at half-tide, opposite the laboratory at St Andrews, whenever I made 'use of a fine seine-net at that place (in September and October), and do 'not doubt that such smaller forms as Buckland describes occur there in 'the earlier part of the year. I have (off the west coast of Ireland) found 'a number of minute post-larval forms, ranging from $\frac{1}{5}$ to $\frac{7}{16}$ inch, which 'appear to me to belong to the turbot; they occurred at various depths 'between 10 and 32 fathoms. I believe that after the completion of the 'post-larval period the young turbot at once approach the margin, and 'reach it before the end of the first year of their life. Otherwise, I do 'not see how the absence of intermediate forms from our collections is to 'be accounted for. They do not occur amongst the young plaice in 'shallow water, nor amongst the young dabs, which extend into depths 'of about 30 fathoms, nor in the deeper water—down to 80 fathoms—'frequented by the young of the witch, pole-dab, lemon-dab, and long 'rough-dab. We have, in fact, no record of their occurrence except at 'the margin.'

My own experience up to date is stated in the Report to Lord Dalhousie's Commission,† and also in the preceding pages. The young turbot of the stages beyond 10 mm. are generally found at the margin of the beach, or in the surface tow-nets close inshore, the smaller forms in the pelagic condition, the larger (about 2 inches), as Mr Holt says, in the seines used from the beach, while those of 5 or 6 inches occur in the salmon stake-nets on the west sands. The older forms, from 9 to 11 inches, abound further out, and formerly were caught by the various kinds of trawlers. It is rare that a large turbot is found in the bay, and, so far as known, never in the ripe condition. As a rule, such large examples are out of condition and useless as food.

In comparing the foregoing form with the brill it is found that the latter in Scottish waters spawns considerably earlier than the turbot, and, as formerly shown by Raffaele, Holt, and myself, the egg is much larger. We have not yet been able to rear the young from the ova to such a stage as to place the life-history beyond doubt, but Mr Holt has recently procured many examples of a post-larval form off the west coast of Ireland, which seems to be the earlier condition of the species just mentioned—especially as they show well-marked otocystic spines and other

* *Report of the Council of the Roy. Dub. Soc.*, 1891, pp. 294 and 295.
† Page 360, 1884.

features which link them on to the older forms. Mr Holt's descriptions and figures will soon be published, but it may be noted that, besides the form of the head and the otocystic spines, the abdomen has a median and two lateral pigment-bands which seem to be characteristic, though traces of such occur in other young pleuronectids. In Mr Holt's words—'Besides the pigment of the median ventral line of the 'abdomen, a 'line of black, with a few yellow, chromatophores occurs on either 'side of it. They diverge from a point in rear of the rectum, run 'forward along the ventro-lateral region, and reuniting in front of the 'pelvics, form a complete loop. This condition at first suggested a 'division of the ventral embryonic fin-fold, such as is described by 'M'Intosh and Prince in their unknown larval pleuronectid (?) A, but 'close examination of both of the entire specimens and of transverse 'sections failed to show the presence of any elevation of the surface. Six 'very distinct pigment-patches occur on the dorsal, four (including the 'hypural patch) upon the post-anal segment of the ventral fin, though the 'pigment of the trunk is not correspondingly broken up into bars, but 'forms continuous lines on the dorsal and ventral edges. As appears to 'be usual in post-larval pleuronectids, the black pigment is more abundant 'on the ventral than on the dorsal fin. The base of the pectoral fin is 'profusely pigmented, and numerous small chromatophores are scattered 'over the sides of the head and jaws and on the snout.' He further notes that in certain of his specimens sufficient progress had been made to show that it was a sinistral form. Of course it cannot yet be absolutely proved that these are the young stages of the brill, but the previous remarks on the turbot and the older stages of the brill would make such a reasonable surmise.

Mr Holt's oldest examples were 9 mm. in length and approached that figured by Raffaele, though his had more profuse pigment. The fin-ray formula is—Dorsal, 80 *Ca*; Ventral, 66 *Ca*. There is a discrepancy, he points out, between this and the adult, but probably considerable change occurs during development. He further adds—'With the increase in 'the height of the body there is a more than corresponding increase of 'length in the interspinous region, which, as we know from Raffaele's 'observations, is responsible for the advance of the dorsal fin in front of 'the head. But the same cause is meanwhile operating in the opposite 'direction, with the result that some of the posterior fin-rays get thrust 'upon the blind side of the caudal peduncle. This occurs, as I know from 'observation, in *R. megastoma*, *H. platessoides*, *A. laterna*, and *P. cynoglossus*, 'and I think there is no reason to doubt it takes place in the turbot and 'brill. We find the presence of rays on the blind side of the caudal 'peduncle as an adult character in the topknots, . . . . . where it is 'obviously to be interpreted as the retention of a larval character; but we 'find no such condition in the adults of the other species enumerated.'

Mr Holt obtained no specimens intermediate between the stage mentioned and one of about 70 mm. (dorsal 81, ventral 63). Raffaele describes and figures two earlier stages, viz., of about 16 mm., and another of 25 mm., with dorsal 80, ventral 60. The otic spines, according to Mr Holt, are as well marked as in specimens of 10 mm. In a post-larval *Solea*, Raffaele mentions a blunt epidermal process on each side in connection with the otocyst (Tav. 3, fig. 6).

The discovery of the elongated young form with otocystic spines by Mr Holt off the west coast of Ireland, and which, as already indicated, he connects with the brill, has caused a re-examination of all the specimens available, and especially of such stages as that represented in Pl. XIX. fig. 1 of the *Researches*, and this examination has been considerably facilitated by the kindness of Mr Holt, who forwarded the above-mentioned young stages of the brill-like form, and also similar

stages of the unknown sinistral form, for comparison with the specimens from the East Coast.

Now, on contrasting the young stages previously described, it is found that the three younger stages—varying from 5·2 to 7·5 mm. in spirit, from Ireland (the coast of Donegal)—have slightly smaller eyes, somewhat longer opisthures, and better-marked pigment,—differences, however, that may be due to the mode of preparation. The older form with the eye on the ridge, on the other hand, closely corresponds with the examples from the East Coast. They all appear to belong to the same species.*

In the *Researches* the next stage of the turbot was supposed to be that described on p. 846, and figured by Prof. Prince in Pl. XIX. fig. 1, a form which has much of the aspect of a turbot, but it possesses otocystic spines, which Mr Holt's discovery shows are present in what he supposes to be the brill, and which hitherto we have not seen on the turbot. Mr Holt has made sections of these and finds that the great otic cartilage is thickened into a sort of knob at the points corresponding to the bases of the spines. Each has a slight basal cavity into which the epithelium lining the otocyst extends, but this exhibits no special sensory structure. Distally the knob of cartilage passes insensibly into a mass of undifferentiated mesoblastic cells, the whole forming a core of a hyaline ossific process. The latter is very brittle, so that its shape cannot readily be determined by the method of section; but examination of entire examples shows that the spines are compressed somewhat in the manner of a pyramid. They are subequal in length, but the lower spines are somewhat broader and more blunt than the upper pair. He records the occurrence of a prominence in the position of the upper otocystic spine in a young turbot, but is not sure what it is, and similar thickenings have occasionally been seen here. The shape of these pelagic brill, moreover, may be more or less abnormal, since Mr Holt points out that all the young forms he procured off the west coast of Ireland were characteristically elongate. In this example the pigment-bars agree with those seen in the Irish specimens of brill; the two otocystic spines are distinct, the dorsal curve of the head and its general appearance, and the comparative size of the eye, all lean to the type indicated by the early forms sent by Mr Holt. Moreover, Mr Collinge carefully calculated the rays of the dorsal and anal fins so as to check the observations already made, and it was found that there were at least 80 rays in the dorsal and 60 in the anal. In another young specimen procured by the 'Garland' on Smith Bank, off Caithness, the two otocystic spines were more prominent, especially when viewed from the dorsum (Pl. XIV. fig. 14). The dorsal had 87 and the anal 62 rays. These somewhat abnormal brill are evidently much older than the doubtful form of 9·5 mm. with the eye on the ridge, as, for instance, may be seen from the condition of the caudal and other fins. Yet the right eye is either just visible from the left, or at anyrate is much less advanced towards the left than in the oldest stage of the unknown form, as figured in Pl. XIV. fig. 11. This would indicate that the latter, in all probability, belongs to a smaller species.

An examination of such small forms as I have been able to obtain gives the following results as regards the fin-rays:—In a young turbot 15 mm. long, captured on the 1st September 1891, and procured from the Plymouth Laboratory, the dorsal had 66 and the anal 48. The upper third of the right eye appears over the ridge, but the pupil looks chiefly to the right, or upwards and outwards. The dorsal is some distance behind the eye. The opercula are spinose. The pigment on the right side is profuse, and only a little less deep than on the left.

An example 21 mm. in length, procured in the trawl on the 21st July

* The excellent figures of Mr Holt will, when published, considerably aid future observers in the department.

1884, has the right eye firmly seated on the ridge, the dorsal terminating behind it. No trace of otocystic spines exists. A little pigment in scattered specks occurs on the right side. The dorsal shows 62 rays, the anal 60. This, therefore, most nearly approaches the turbot.

The next specimen to be considered in this connection was captured in the hand-net at the tidal margin of the Eden on the 11th August 1884, and measures about 22 mm. The body generally resembles that of a brill. All that indicates otocystic spines, however, are two hard patches on each otocyst. Though the left is the deeply tinted side, the right has also a general distribution of blackish chromatophores in the spirit-preparation. The dorsal has 75 rays; the anal has 54. Both eyes are on the left, and the dorsal has advanced to about the mid-ocular region.

A specimen reaching in all probability to 23 or 24 mm. (for the tail is injured) comes from the same place (estuary of the Eden) on the 25th July 1884, and in coloration it corresponds with the foregoing. The right eye is not quite so far to the left, for the dorsal fin has not reached the centre of the eye. The dorsal has 74 rays, and the anal 56 to 57 rays. It is probably a brill from which the spines have disappeared, but it also approaches the turbot, though the dorsal rays are more numerous.

A somewhat larger specimen captured in the trawl on the 20th August is 29 mm. in length and resembles a brill in general outline. The right side has many blackish pigment-specks, as in the younger forms. Two hard regions occur on the otocyst, but no spines. The dorsal fin has advanced considerably in front of the right eye, which is separated by a distinct space from the fin. The dorsal has 75 to 76 rays, the anal 59. The microscopic investigation gives no help in determination, for scales are not yet developed.

In order to test the condition of the rays of the dorsal and anal fins in young forms about which there could be no doubt, Mr Collinge examined for me eight young turbot ranging from 41 to 62 mm. In any order these present the following conditions:—

| Dorsal. | Anal. | Dorsal. | Anal. |
|---|---|---|---|
| 59 | 50 | 65 | 48 |
| 65 | 53 | 67 | 53 |
| 62 | 47 | 66 | 54 |
| 61 | 46 | 66 | 52 (41 mm. long) |

Thus none presented a higher figure than 67 for the dorsal, or had fewer than 59; while the highest for the anal was 54, and the lowest 46.

A young turbot, 6 by 4½ inches, from the seine of 5th February 1892, had dorsal 62, anal 50, and caudal 17.

In the same way two young brill measuring respectively 50 and 61 mm. gave—

| Dorsal. | Anal. |
|---|---|
| 82 | 69 |
| 77 | 62 |

In considering the rate of growth of the young turbot, the condition of some of the common pleuronectids, such as the plaice and dab, may now be examined.

In May the rock-pools at St Andrews abound with young pleuronectids, ranging from 14 to 17 mm., with a considerable amount of pigment on the right side, and affecting both fins and general surface in the usual manner, while the left side is quite pale. Both eyes are on the right, though the left is still on the ridge, and can be seen in almost all from the left side, the rate of progress varying according to the degree of development. They are evidently very young fishes; yet the development of the fin-rays has made rapid progress since the pelagic stage, the tips of the rays now projecting

beyond the intervening membrane. No spine appears in front of the anal fin. Of thirteen examples captured in the pools on the 13th May, and ranging, as above stated, from 14 to 17 mm. in total length, the following condition of the dorsal and anal fins was found:—

| Dorsal. | Anal. | Dorsal. | Anal. |
|---|---|---|---|
| 75 | 59 | 69 | 57 |
| 72 | 58 (17 mm.) | 68 | 53 |
| 72 | 58 | 67 | 47 ? (injured) |
| 72 | 57 | 66 | 56 |
| 70 | 58 | 61 | 56 (14·5 mm.) |
| 70 | 57 | 61 | 55 (14 mm.) |
| 70 | 56 | ... | ... |

In all probability the majority are young plaice or young dabs, the normal number of the rays in the former, according to Day, being from 66–77 for the dorsal and 50–57 for the anal. In the latter species there are from 65–78 in the dorsal and from 50–62 in the anal. It is interesting to note that the smallest forms have fewest rays, and it is possible that at this stage the fin-rays may increase, more especially in the dorsal, for a glance at the number in the anal shows that diminution in a few (those with 58 and 59) must occur, if the supposition that plaice are present is correct, since the normal number is about 57.

These pleuronectids were not present in the pools before April, have apparently taken to the ground after the pelagic stage, and, moreover, must have sought the tidal margin.

The history of the dab has been followed by various authors. In the Trawling Report of 1884 allusion is made to many small specimens, and, further, it was pointed out that a large proportion of immature dabs are found not only in shallow bays, like that of St Andrews, but at considerable distances from land; and thus a doubt was raised as to whether all the young forms had been reared inshore on a sandy beach. Similar observations have recently been made by Mr Cunningham at Plymouth. The latter author gives the following table as the result of his experience of the growth of the dab:—

| | |
|---|---|
| 1st year, . . . . . | 2–6 inches. |
| 2nd " . . . . . | 5–8 " |
| 3rd " . . . . . | 7–10 " |

Taking March, April, and May as the chief spawning months, it is found at St Andrews that many are only from 15 to 18 mm. the following January, many from 19 to 52 mm. in March, in April 1⅛ inch, while in June many range from 1½ to 1$\frac{11}{16}$ inch, which should carry them to the end of the first year. It is true that in April, along with the former, some reach 3⅝ inches, but their age is uncertain, and so with those of a larger size in May and June. It would be remarkable if the dab should frequently attain the length of 6 inches the first year, and further investigations are required on the subject. Those hitherto made at St Andrews do not make this clear. During the second year they probably range from 2 to 6 or 7 inches, but on this point there is still need for accurate observations.

In regard to the growth of the turbot, Mr Cunningham * is of opinion that those collected at the surface of Mevagissey Harbour by Mr Dunn, and measuring 1·0 and 1·5 inch, were about one month old, while those of ·6 and ·8 inch ranged to three weeks. On the other hand, Mr Holt thinks that at 7·5 mm. the unknown sinistral pleuronectid is only about three weeks old, while at 10 mm. it will be not less than two months old, but this may pertain to a smaller species, such as the topknot. It is, at any rate, at variance with my experience to assign the age of one month to a turbot an inch long.

* *Jour. Marine Biol. Assoc.*, new series, ii., No. 2, p. 105.

It would appear that the spawning season of the turbot, as in many other species, extends over a considerable period, and thus not only are the examples of the young at a given date necessarily of varying size, but the usual irregularity of growth in specimens of the same age has also to be taken into account. If we are right in supposing that the turbot occasionally spawns in May, it is clear that some examples at least have a considerable interval for growth before the end of July and the beginning of August. We lose sight of the small specimens, for the most part, until they appear in the inshore water as fishes about an inch in length at the end of July and beginning of August, when they are captured either at the tidal margins or at the surface in harbours and sandy bays. The fact that no smaller specimens are obtained previous to the appearance of such forms would indicate that they are immigrants, though it must be borne in mind that the larvæ from the pelagic eggs carried shorewards are on the spot, and that they, for instance, may have sought the margins or the surface after being hatched in the bay itself. Those specimens measuring about an inch in length at the end of July and beginning of August may therefore have a period of three months or upwards since deposition of the ova took place. The growth is thus somewhat rapid after a length of 10 mm. is reached, but not more rapid than what is to be expected in a fish having an adult so large as the turbot. Again, those ranging from 41 to 62 mm. on the 7th September at the margin of low water have a period of about four months and upwards from the earliest deposition of the eggs, and there can now be no ambiguity about the species; but there is great disparity in size, in the condition of the right eye, and the anterior margin of the dorsal fin. In all, however, the right eye is on the left side. Some are evidently considerably older than others, and have longer and thicker bodies. Day speaks of one 1½ inch long, captured on the 20th August, in which the right eye was still 'in transit passing round 'the bones of the head;' but he does not give details as to the exact position of the eye, and in some the right eye is on the left before this length is reached.

Those of 5 to 6 inches, procured in February and in April in seines and salmon stake-nets, would appear to be the young of the previous season, and therefore range from eight to ten months, and this agrees with the opinion advanced by Mr Cunningham. In St Andrews Bay the turbot of 5¼ to 6 inches, which are sometimes numerous in the stake-nets on the west sands in April and May, would appear to reach the length of 9½ to 10 inches or a little more in September, and thus would be fully a year old. The growth is therefore fairly rapid if these interpretations are correct. Unfortunately we have no absolute proof of the rate of growth.

### 3. On an Unknown Post-Larval Fish from Smith Bank.

In the mid-water net on Smith Bank, 28th June 1889, a form (Pl. XV. fig. 1) differing from anything hitherto observed was procured along with young gadoids, gurnards, and pleuronectids. It is distinguished by the great thickness of the body—the depth of which, moreover, is comparatively moderate, by the character of the head, and the presence of branchiæ projecting behind the opercula. It is not a very young fish, to judge from the thickness and firmness of the body and the condition of the branchiæ, yet the embryonic tail is still present. The total length is 9·5 mm., the greatest depth is about 3·8 mm. The vent is situated a little in advance of the median line of the body, which is speckled with minute blackish-brown points on the head and lateral regions, and by similar specks of pigment over the abdomen, the latter, however, having undergone considerable change, a change often seen in other forms after immersion in spirit, viz., a spreading out of the marginal pigment, while a black speck

remains in the centre. The specks on the lateral region are dotted with some regularity. Indications of two pigment-touches occur in the dorsal (marginal) fin, viz., over above the tip of the pectoral, and another about the centre of the post-abdominal region of the body. Ventrally a single patch is situated midway between the anus and the hypural region. The pigment invades the fin, and thus resembles that in the pleuronectids generally. On viewing the dorsal surface from above, the cephalic and the two marginal touches, which extend on the fin, are best seen. Ventrally a little pigment over the abdominal surface and the patch in the anal fin are noticeable, while chromatophores are dotted round the anus. The pigment is alike on both sides.

The eyes are of considerable size, and are lateral in position, that is, one on each side of the body.

The marginal fin is considerably injured, but it seems to have been of moderate depth, traces of true rays appearing both dorsally and ventrally, and particularly in the caudal.

The terminal bend of the notochord is pronounced, but does not taper much, and the embryonic fin forms apparently a shorter lobe than in the pleuronectids hitherto examined. A few black pigment-specks occur inside the abdominal cavity, as viewed from the ventral surface.

At first sight the thickness and elongation of the body suggest the young of the halibut; yet there is nothing in its structure which would militate against its being a young turbot. I am inclined, however, to connect it with the former.

Specimens of very young halibut are extremely rare, apparently because they are found only in deep water on the great fishing grounds. The smallest examples hitherto examined here were two from St Andrews Bay mentioned in the Fourth Annual Report of the Board (p. 209). They were obtained by a local trawler, but similar small specimens are occasionally caught on the lines. The larger of the first mentioned measured a foot in length.

The laboratory attendant (A. W. Brown) procured in the deeps (105 fathoms) about 50 miles from the coast of Norway, and about 220 from Aberdeen, on the 31st May this year, a young specimen, apparently of this species, measuring 97 mm., or a little more than $3\frac{3}{4}$ inches. It had been swallowed by a green cod. Its fin-formula is D 97, A 73 (?), caudal 19, pectoral 11, ventral 6, though it must be stated that digestion had affected the fins considerably.

The chief differences between this small sample and one a foot long are the proportionally large size of the eyes, and their proximity to the anterior border of the snout, the smallness of the gape—the posterior angle of the mouth being somewhat in front of the eye; whereas in the larger (1 foot), it passes to the anterior fifth of the eye, and the maxilla is boldly marked. The arch of the lateral line behind the eye on the right side is much more pronounced in the larger example, for in the smaller it is gently bent upward, and runs forward with a very slight declivity. On the left side the arch is more distinctly curved. Variations, however, are frequent in the larger examples. The caudal rays proceed from a nearly vertical line in the smaller specimen, from a semicircle (*i.e.*, a line convex backward) in the larger. The opercular region also differs, but the actions of the gastric juices have made changes in the small specimen. The thickness and narrowness of the body are more or less diagnostic at this stage.

### 4. On the Eggs of the Halibut.

Hitherto the ripe eggs of the halibut have escaped observation, at least so far as accurate description goes. The spawning period, indeed, even in the case of Fishery officers stationed where hundreds are landed

monthly, is full of uncertainty; and Dr Fulton mentions that in working up the returns in regard to reproduction he could come to no definite conclusion as to the spawning season of the halibut. Parnell, in his *Fishes of the Forth*, states that the halibut spawns in spring. J. Couch, again, does not refer to the subject, though R. Couch, according to Day, gives April as the spawning period. Buckland quotes the period given by Parnell, and adds that the roe is of a pale red colour and the ova numerous—a remark, however, which is applicable to many forms. Day has nothing to add to the foregoing. Möbius and Heincke observe that the spawning period occurs in spring, and state that Malm found in the Cattegat a ripe female on the 26th April. Brook gives the spawning season on the West Coast as from March to June. Fulton, again, in last year's Report,* found an advanced specimen, captured east of the Island of May, with the ovaries of a pinkish tinge, on the 18th of February, and others less advanced in June. Like other pleuronectids, therefore, the halibut spawns early in the year, and probably continues to May or June. Dr Fulton notices that the eggs were comparatively large even in February. In June, again, he found the ovarian ova reached 1·27 mm. in diameter, but they were far from ripe, as indeed were those and other specimens he kindly forwarded to St Andrews in May and June. No ripe example was seen amidst the many hundreds from Iceland and Faroe, examined on the pontoon at Grimsby about the middle of the latter month. The men, moreover, appeared never to have seen a ripe specimen.

About the beginning of May Mr Holt kindly informed me that he had secured the fresh eggs of this species at Grimsby, and that they ranged from 3·07 to 3·81 mm. in diameter, were destitute of an oil-globule, and delicate to handle. The capsule had faint scribbled markings. They are thus the largest pelagic eggs off our shores; indeed, Raffaele in the rich Bay of Naples appears to have found none over 3 mm. in diameter, though Wenckebach subsequently found one of 4 mm. Mr Holt mentioned that they collapse and burst very readily, and thought it possible that a large perivitelline space is formed after fertilisation, as in the long rough dab.

Immediately afterwards Dr Fulton secured ripe eggs through Mr R. Mackie, Assistant Fishery Officer, Peterhead, who removed them on the 27th April 1892 from fishes which had been three days on board. The halibut were caught on Bergen Bank, about 60 miles off the Fair Isle, and 150 miles E.N.E. from Peterhead. The specimen from which the ova were procured weighed about 140 lbs., and the roe from 18 to 20 lbs. Roe 28 lbs. in weight has been found in the halibut.

The eggs were preserved in a strong solution of picric acid, and of course had shrunk considerably, and the apparently mature were mingled with numerous unripe eggs. The perfectly ripe eggs appeared to be nearly circular, and had a diameter of about 3·3 mm. Those less advanced, though fully 3 mm. in diameter, were more or less ovoid, as usual in unripe forms. So far as could be ascertained, the capsule (*zona radiata*) had the same structure as in other forms, and the external surface was smooth and glistening. As Mr Holt pointed out, it is comparatively thin for so large an egg. The condition of the micropyle could not be made out.

Along with the foregoing large eggs were many nearly uniform in size (1·9050 to 2·0574 mm.). It is probable that most of the eggs, which in a given season are ripened and shed, increase to a size more or less uniform, but considerably less than the diameter of the mature egg; and that the subsequent increase to the mature condition takes place more rapidly than the previous growth. Such is the general impression, though no exact observations have been made.

A large number of apparently ripe (though dead) eggs of this species

* Page 261.

have been received from Dr Fulton since the foregoing paragraphs have been in type. They are the largest and perhaps the most beautiful of all the pelagic ova (Plate XVI. fig. 13). Thus the dubiety enshrouding the reproduction of this species is gradually disappearing. The eggs have a diameter ranging from 3·4290 to 3·7619 mm., and before being immersed in sea-water, resembled a slightly milky mass of young salpæ, or a quantity of boiled sago, their diameter, however, being considerably less, viz., from 3·0480 to 3·2766 mm. Many had been ruptured, the fluid in the bottle being thus milky.

The capsule is evidently thin, and before the imbibition of sea-water, it flapped to and fro with the movements of the fluid in which they were immersed. It subsequently, however, became tense, and exhibited slight elasticity, the eggs being easily lifted by a pair of fine forceps and transferred from vessel to vessel. If the egg happened to fall an inch or two on a glass plate, immediate rupture ensued. Proportionally, therefore, the capsule is the thinnest yet met with in the group. As in other cases, sea-water readily penetrates and distends the capsule. The latter is marked by a series of fine creases or folds, which have a somewhat coursed or even stellate arrangement, like those of the lemon dab or brill—an arrangement best seen in the egg before distension, though it is also visible in the tumid egg (Pl. XVI. fig. 22). The minute punctures occur all over the surface. The folded edge of the capsule, in a ruptured specimen, is marked by closely-arranged striæ—an appearance often seen in shrivelled eggs of other species.

Careful search of the surface of these specimens showed only a simple micropylar orifice (Pl. XVI. figs. 11 and 12). It had a slightly pinkish hue (like the large pores in the capsule of the torsk), probably from refraction. No special arrangement of lines or pores surrounded the orifice.

As Mr Holt mentioned, no trace of an oil-globule is present, the yolk being apparently quite transparent and homogenous. In the present instance, the whitened (dead) protoplasm occupied one side, leaving the rest of the egg more or less transparent.

### 5. On the Eggs of the Green Cod (or Saithe).

Notwithstanding the abundance of this species on the coasts of Scotland, ripe specimens have up to this period escaped us. Recently spawned examples, it is true, have more than once been picked up on the beach early in the year (March), but none with mature ova.

Parnell * observes that the spawn is deposited in the early part of the spring, and the fry are seen in June, about 2 inches in length. Couch gives the same spawning season, and mentions that the young are caught off the rocks in Scotland. Day writes that in Cornwall they spawn in spring, and that in the Orkneys the young in June reach 1½ inches, and in August from 3 to 5 inches. Möbius and Heincke mention that, according to Kröyer, the species spawns in spring. Brook extends the spawning period from December (Wick) to April (Berwick), most of the entries by the Fishery officers being in March. Fulton † procured a tolerably ripe female on the 11th March, the large clear eggs being from 0·9 to 1·8 mm.

By the courtesy of the Fishery Board, and the exertions of Dr Fulton, a few unfertilised eggs of this species were forwarded in sea-water from Shetland, having been procured by Mr Robert Duthie, the Assistant Fishery Officer, on the 9th of April 1892. Unfortunately, they had decayed, the ruptured capsule in many alone remaining. A few, however, were still fairly rotund, and these had a diameter of 1·1430 mm.,

* *Fishes of the Forth*, p. 347.
† *Ninth Annual Report Scottish Fishery Board*, p. 258.

so that they would seem to be somewhat less than those of the cod, though they may really be about the same size, since these unfertilised ova, are generally a little less than the floating fertilised forms. The capsule (*zona radiata*) has at least the usual specimen was slightly wrinkled, a feature, howe immaturity. The micropyle resembles that in th

### 6. On the Eggs of the Pollack (or Lythe).

Accurate information concerning the spawning of the pollack has hitherto been scanty, and, unfortunately, on the present occasion only the preserved ova have been procured. Mr Holt who last year obtained two ripe specimens of each sex in April, and a ripe female in May, off the west coast of Ireland—was of opinion that the pelagic ova did 'not differ much 'in size from those of the whiting and poorcod, from which they are not 'otherwise distinguishable in the early stages.'†

Parnell, in his *Fishes of the Forth*, states that it spawns in February, after which it remains out of condition till May. Buckland, on the authority of Mr Dunn, observes that it spawns in winter, and that the young are seen in April an inch long, and quite black. Couch thinks it spawns about the end of the year, and the young, of small size, are seen in harbours and on the borders of shallow rocks, moving about with a slow motion, and readily taking a bait. Day gives the early part of the year as the spawning period, and mentions that on the 28th May 1881 he received some specimens, from $\frac{7}{10}$ths to an inch long, captured at the surface. No scales, or even ventral fins, are visible until the fish had obtained $\frac{4}{5}$ths of an inch in length. Brook gives a wide range, on the evidence of the Fishery officers, beginning with December at the northern stations (Wick), and ending with April and May at the southern (Berwick). Möbius and Heincke are uncertain on the subject, but say it probably spawns towards the end of winter.

In all likelihood the pollack covers the usual area in regard to spawning, commencing perhaps in January and continuing in some cases till May, the latter being the period (7th May) on which the ova were procured by Mr R. Duthie from an example captured 5 miles off Bressay, Shetland. They were placed in picric solution. The average diameter of the best examples was between ·9906 and 1·0287 mm., a diameter very similar to that of the cod, removed from the fish and placed in spirit, and then in the same solution of picric acid and spirit; only the number of ova of the pollack which grouped themselves round the lowest figure (·9906 mm.), was greater than in the case of the cod.

### 7. On the Eggs of the Torsk or Tusk.

Couch (iii. 97) says the torsk comes (from deep water) near the coast at the time of spawning, which is in January and February. Parnell, again, states that it spawns in April and May amongst the sea-weeds along the coast. Day, like Parnell, seems to have copied this remark without query. Brook, in the Scottish Fishery Board Report (1866), gives, on the authority of the Fishery officers, March at Wick, May and June at Peterhead, and the same two months at Lerwick. Dr Fulton, who had the opportunity of examining the eggs of two very fine specimens of 34 inches, and weighing respectively 15 lbs. 5½ oz. and 15 lbs., calculated that the partially developed ova in the former were about 2,283,979 in number, whereas in the latter, which he thinks had discharged part of them, the ovaries contained 790,064. In the latter example, 40 or 50 in 3612 ova, which were counted, were large clear eggs, having a diameter of 1·4 to 1·32 mm.

* *Researches*, pl. i. figs. 12 and 13.

† *Report of Council, Royal Dublin Society*, 1892, p. 252.

Little was thus known of the breeding of the torsk or tusk (*Brosmius brosme*, O. F. M.), though from its close relationship with the ling and rockling it was supposed to have an egg with an oil-globule. Various attempts had been made by the Board and others to secure ripe examples of the fish, but hitherto without success. The energetic efforts of Dr Fulton, however, have at last procured specimens of the ovarian eggs, more or less ripe. They were obtained by Mr Mackie, Assistant Fishery Officer, Peterhead, from a boat fishing on the Bergen Bank, about 60 miles from the Fair Isle, and 150 miles E.N.E. from Peterhead, on the 27th April 1892. The three series of eggs were removed from fishes which had been three days in the boat, so that their condition was somewhat unsatisfactory. They were not fertilised. Another well-preserved series sent by this energetic officer contained some very large ripe eggs, fully 1·4097 mm. in diameter.

As usual under such circumstances, a number of unripe ovarian ova were mingled with others more or less ripe, the diameter of the latter in a fluid consisting of one-half saturated solution of picric acid and half spirit, ranging from 1·2573 mm. to 1·3335 mm., the latter being approximately the average of ripe eggs after preservation, so that in all probability they are about the size of those of the gurnard, and, like the latter, possess a large oil-globule, as in the ling and rockling. If the size of these preserved ova be compared with those given by Dr Fulton in the fresh condition, it will be found to correspond very much with what takes place after preservation in other forms. In all probability the fertilised free floating eggs of this species will not be less than from 1·4 to 1·5 mm., or perhaps a little more. As in the case mentioned by Dr Fulton, the majority of the smaller unripe ova ranged between ·7 mm. and ·9 mm. The condition, however, does not materially differ from that of allied fishes, such as the cod and haddock. The *zona* is smooth and glistening.

A large consignment of fairly ripe ova was forwarded from Shetland by Mr Duthie the Fishery officer, viz., two preparations procured on the 28th April, and a third, more numerous than the preceding, on the 3d May 1892. The former was obtained twenty miles off Lerwick, and the latter forty miles off the same port. Their diameter on the whole was somewhat less, but such was probably due to the preservative fluid. A large number of ripe ova had evidently been present in these fishes.

The foregoing had been sent to press when, on the 25th May, a large series of living eggs of this species was forwarded by Mr Duthie, Assistant Fishery Officer at Lerwick, whose perseverance under many difficulties and whose final success deserve much commendation. Mr Duthie had less difficulty on several occasions in procuring ripe females, which, as Dr Fulton and others have shown, possess large ovaries; it was the condition of the males which puzzled him. The spermaries of the males (several examples of which were forwarded) are small, reaching in the preparations only from 2 to 3 inches in a male of good size, and having the form of a frilled cord or riband. They thus differ materially from the condition in the cod.

The ova were almost dry on their arrival, many adhering to the cheese-cloth which covered the jars, and their hardihood was perhaps partly due to the fact, so often seen in other forms, that they had reached a certain stage of development (Pl. XV. fig. 8). The torsk were caught about 20 miles off Lerwick on the 21st May, and Mr Duthie fertilised them the same evening; they were thus in their fourth day. They had an average diameter (and they were nearly uniform in size throughout) of 1·3335 mm., so that the preserved examples from Peterhead alluded to above, and the

largest of which had no less a diameter than 1·4097 mm., must have been exceptionally fine, and, moreover, well preserved. The large oil-globules, which had a diameter of from ·2286 mm. to ·2667 mm., appeared under the lens of a pale reddish-brown hue, but by transmitted light of a pale red. In some a series of minute fatty granules were also present under the large globules, as indicated in the figure (Pl. XV. fig. 8). No pelagic egg, with the exception of the sand-eel, has presented a more distinctive colour. The zona is remarkably tough and resistant, and the fresh egg can only be ruptured by the exercise of considerable force. It presents on the surface of the entire egg (Pl. XV. fig. 5) a series of boldly-marked punctures. In some views they have a slightly pinkish hue from refraction, and under a higher power (Pl. XV. fig. 6) they give the capsule a minutely pustulose appearance. If a fragment of the zona be allowed to dry on a slide, each of the punctures enlarges, and becomes the centre of a curiously wrinkled margin, with numerous processes, such as would have been caused by a protoplasmic environment (Pl. XV. fig. 7). In the present case, however, it was probably due to wrinkling of the dried zona. The latter, in the fresh example, is further marked by faint lines or creases, which in some are crossed by another series of lines or creases, so that the appearance is similar to that in the zona of the brill, lemon-dab, and sail-fluke. The micropyle is very evident, and after the plan of that in the egg of the haddock; the external aperture, which is in the centre of a depression, is smaller than the internal.

The stage which the eggs had reached on arrival (4th day) is shown in Pl. XV. fig. 8, the blastopore closing, or closed, the optic vesicles formed, and a broad alar expansion extending on each side. A small perivitelline space is present. Development proceeded normally, so that two days later (27th May) a number of myotomes were formed posteriorly; a considerable portion of the tail was free, the pectoral folds formed; lenses, otocysts, and a heart in which slight contractions were visible (Pl. XV. fig. 9). Moreover, a few simple pigment-specks are scattered over the free portion of the tail. The embryo jerks body and tail. All the ova lie on the bottom of the vessel.

Next day (28th) the eggs had made considerable progress (Pl. XV. fig. 10). Black chromatophores are studded along the sides of the body and on the head, and some of these are slightly stellate on the head and near the pectorals. The heart has its open end as usual to the left and in full action. Each otocyst has two otoliths. The pectorals project outward as rounded lobes. In the specimen figured a peculiar conical cutaneous knob projects outward from the head in front of the otocysts. The tail is much elongated, and has a group of black chromatophores at the tip. The perivitelline space is larger.

Before hatching, a greenish-yellow hue (by transmitted light) appeared on the head and on the tip of the tail, as indicated in Pl. XV. fig. 11. None were hatched on the 29th, but on the 30th May, at 11 a.m., that is on the 9th day, some emerged. The larva measures about 4 mm. in length (Pl. XV. fig. 12), and is characterised by the large pinkish-brown oil-globule which is generally fixed at the posterior border of the yolk as in the figure. In some, however, the oil-globule is freely movable, a feature, in such larval forms, which has hitherto escaped me. By depressing the tail of the larva, the oil-globule glides forward to the middle of the yolk, and by elevating the head it mounts to the highest point, viz., the anterior border of the yolk. Nothing, indeed, could better illustrate the features formerly pointed out in regard to the movement of the oil-globule in the gurnard,* and the passage of the brightly-coloured globule through the yolk (and not merely at the surface of the yolk as some imagine) was

* *Researches*, p. 687.

in this instance easily followed. The free condition of the oil-globule in these instances was probably abnormal, but it is worthy of note. Five conspicuous black patches or bars further distinguish the larva, viz., one on the head and four on the body. The chromatophores on the head are somewhat irregularly scattered, though the front view of the head *in ovo* (Pl. XV. fig. 11) shows that a more or less symmetrical series occur over each eye. The first patch or bar on the trunk is placed rather behind the middle of the yolk, though a little variation exists, and it is rendered the more conspicuous as the black pigment of the sub-notochordal region is present beneath (Pl. XV. figs. 12–14). The chromatophores in these areas are very finely ramose. The next patch or bar lies on the muscle-plates behind the vent, the last is at the top of the tail, while a less definite one is intermediate. As already mentioned, a slightly yellowish hue (greenish by transmitted light) pervades the head, yolk-sac, and the tip of the tail. No sign of the cutaneous process in front of the otocyst is now visible, so that it may have been idiosyncratic. The rectum is high up on the marginal fin, but the lumen is visible just within the tip. The urinary vesicle is distinct. The notochord is multicolumnar. The surface of the yolk-sac, the pectorals, and the marginal fins are minutely vesicular. A little black pigment appears in the eye. The healthy larvæ are active.

Next day (31st May) the chief feature was the increase of the greenish-yellow hue on the under surface of the head, on the yolk-sac, and the tip of the tail, this tinge being due to the development of the cutaneous vesicles formerly mentioned, and it makes a bold contrast with the pinkish oil-globule. The ramifications of the black chromatophores have everywhere increased, those at the tip of the tail having a radiate arrangement like fin-rays. The liver appears on the ventral border of the gut. The rectum has moved downwards a little, and often contains a rounded mass. The pectorals and otocysts are larger. A peculiar abnormality occurred in an example (Pl. XVI. fig. 19), viz., the presence of a long narrow process (*a*) resembling a diverticulum in the rectum, which in this instance had reached the somewhat defective border of the fin.

The changes which were visible on the 1st June consisted of the projection of the cartilages of the mandible, the increase of pigment in the eyes, and the passage of the rectum, with the urinary vesicle, near the fin-margin (Pl. XV. fig. 13 and Pl. XVI. fig. 13). The little fishes are restless, and the use of the pectorals in balancing is more pronounced. The yolk has considerably diminished. Next day the eyes showed a greenish silvery lustre, and peristaltic movements of the gut were marked. Moreover, though the mouth is still closed, spasmodic movements of the mandibular region occur. As in the cod, rockling, and other forms, the black chromatophores, when placed against a dark background under a lens, look brownish.

On the 3rd the larva were characterised by their activity, and especially by the rapid vibrations of the pectorals. The yolk has now greatly diminished, only a small anterior portion (Pl. XV. fig. 13) now remaining, while the reddish-brown oil-globule has been drawn forward and almost concealed under the greatly increased black pigment of the upper region of the abdomen.

The larvæ on 6th June, that is about a week after hatching (Pl. XV. fig. 14), swam more readily, and the mouth had opened, the mandible being moved up and down with the hyoidean apparatus. Only a trace of the oil-globule remained, and the yolk was almost absorbed. The rectum had not yet reached the border of the marginal fin, but it was close to it, and its margin was slightly papillose. Little change had taken place in

the pigment of the body, but the caudal patch had spread out in a characteristically fan-shaped manner (Pl. XVI. fig. 21), coincident with the development of embryonic rays in the tail, and the yellowish tint of the marginal fin in the same region had somewhat increased. The caudal region of the marginal fin seemed to be somewhat less. They are hardy larvæ, and could without much difficulty be reared in large numbers in a suitable enclosure.

### 8. On the Development of the Sail-Fluke (*Arnoglossus megastoma*).

The earlier writers do not appear to have seen a ripe sail-fluke, or 'megrim,' as it is often called by the Scottish fishermen. No mention of the subject again is made by Parnell or Couch. Day observes that 'Thompson on 31st October at Belfast procured one which had just shed 'its ova, only a few mature ones remaining.' Raffaele * pointed out that the ova of *Arnoglossus* have a single oil-globule, and his figure generally resembles the egg of the present species, except that he does not allude to the minute structure of the zona. His figure, however, of the larval *Arnoglossus* (Zona 4, fig. 20) differs materially from that of a *A. megastoma* both in structure and coloration. Whether the figure of the careful Italian author refers to *A. laterna* or other form, however, is unknown. Dr Raffaele finally represents the post-larval *Arnoglossus* with a long ray like a flagellum anteriorly.

Mr Holt,† who found ripe forms of both sexes in March, April, and May, states that the eggs are very translucent, and, like those of the brill, have a single oil-globule (diam. ·30 mm). The diameter of the ova is from 1·08 to 1·13 mm. He thinks, from his observations off the west coast of Ireland, that spawning takes place only in moderately deep water, or in very deep water, and necessarily therefore at some distance from shore, always at a great distance from the coast, when the declivity is very gradual. On the eastern shores of Scotland the species is an inhabitant of the deeper water.

Three series of ova were received from Aberdeen, viz., two on the 24th May, and the third on the 28th May. The first two were both dead, one having been fertilized on the 21st May, and the second that morning (24th). The former had a diameter of 1·1430 mm., and the clear, colourless oil-globule about ·25 mm., and the latter a diameter of 1·2192 mm., and the oil-globule ·3048 mm. The third series reached the laboratory on the 28th May at 11.30, at an early stage of development, and had a diameter of 1·1430 mm., while the oil-globule had a diameter of ·3048 mm. All the living eggs were remarkably buoyant, and had a perivitelline space.

The capsule (Pl. XVI. fig. 1) in this species conforms to the type seen in the brill and lemon-dab, being covered with raised lines or ridges, with very fine striæ between them. When viewed from the outside under a high power, the capsule (zona) presents the usual minute punctures densely dotted over the surface. The micropyle is difficult to distinguish, but it appears to be sometimes situated in the centre of a radiate series of lines in a space, bounded by other ridges (Pl. XVI. fig. 10). It is best seen by setting several eggs together on the bottom, so that they support each other, and give special positions not seen when each is free.

On the 29th May (next day) the rim had either reached the equator or had extended beyond it (Pl. XVI. fig. 2), and a dimple was often present on each side (in optical section) where the rim constricts the yolk. The

* Le uova galleggianti, Mit. a.d. Zoolog. Stat. zu Neap. viii. Bd. i. Heft. 1888. Sep. Abd. p. 49, &c.

† Report of Council, Roy. Dub. Soc. 1891, p. 238.

following day (30th May) the embryo was fully half round the yolk (Pl. XVI. figs. 3 and 4) and the perivitelline space had increased. The lenses are now present, and black chromatophores appear in the caudal region and under the oil-globule.

On the 31st the increase of the perivitelline space was more marked than on the 30th—from the diminution of the yolk, the tail of the embryo projects as far as the oil-globule, and the black chromatophores of the tail are conspicuous, and have commenced to ramify. Black pigment appears along the sides of the embryo. The chromatophores under the oil-globule are more numerous, and are minutely branched. The otocysts are visible, and the heart exhibits faint contractions.

At 4 p.m. on the 1st of June two larvæ were hatched—it may be somewhat prematurely. The larva (Pl. XVI. fig. 5) possesses only black pigment, which is somewhat uniformly scattered over the body, with a few specks on the head. The black chromatophores also occur, both dorsally and ventrally, in the marginal fin. Thus five or six V-shaped chromatophores are found near the margin of the dorsal fin behind the yolk-sac, almost intermediate between it and the tip of the tail, and two similar or somewhat triangular ones are present ventrally, opposite the former. The large oil-globule lies at the posterior and inferior part of the yolk, and has the usual black chromatophores. The otocysts are simple sacs. No pigment exists in the eyes. The notochord is distinctly multicolumnar. The solid strand of the rectum comes to the edge of the marginal fin, and a pre-anal portion of this fin occurs between it and the yolk. The urinary vesicle shows only a small central chamber.

Next day other larvæ appeared, some considerably more vigorous than those of yesterday. They float with the yolk-sac uppermost (Pl. XVI. fig. 7), and have only black pigment. The oil-globule in lateral views is somewhat elliptical (Pl. XVI. fig. 6).

On the 3rd June yellow pigment was apparent amongst the black in the marginal fin, and also along the sides of the body posteriorly. None was present on the head. The yolk-sac has, as a rule, no pigment-corpuscles, only one or two black chromatophores appearing occasionally at the upper part of the region.

The enlargement of the otocysts, liver, and other organs is considerable, and the skin is assuming a minutely vesicular condition. In larvæ which only escaped from the capsule to-day the yellow pigment was noticeable on the caudal region on extrusion. In these, as in other species, the difficulties of hatching are increased by the emergence of the tail first, as the zona clasps the yolk and prevents its exclusion. Some die in this position. The capsule (zona) retains the ridges and lines after hatching has taken place.

The mouth in this species seems to open comparatively early, and on the 6th June it formed a conspicuous aperture, as shown in the dead example sketched in Pl. XVI. fig. 9. It is more anterior in a living specimen, as the parts have been drawn backward. The under surface of the head in many views has a tuberculate appearance from the lateral processes of the opercula. Three arches are observed through the branchial aperture. The shape of the head is also peculiar. The pericardial chamber is very large, so that the heart seems to be further back than usual. The yellow pigment has largely increased along the muscle-plates, pre-anal region, and elsewhere.

On the 7th June black pigment was developed in the eyes. The oral aperture differs considerably from that in the gadoids, since the mandibular cartilages are much less developed, yet the aperture is proportionally large and the movements extensive. The yolk has diminished. The opercular eminence (Pl. XVI. fig. 8), gill-aperture, and branchial arches

are all distinct. The pectorals are larger, and are used for balancing. The skin is minutely vesicular, and the canary-yellow pigment is conspicuous in the posterior part of the body.

So far as can be ascertained, the foregoing larva differs from any form described by Dr Raffaele. Professor Marion, however, in the recent publication already quoted, gives an excellent figure of a larval form which was hatched on the 1st of May, and which he associates with the gurnards, from its resemblances to the larvæ of such forms as *T. aspera*, *T. gurnardus*, and *T. cuculus*. It, he says, evidently pertains to another species, and hence he doubtfully diagnoses it as the larva of *Trigla corax.*(?) If, however, his figure be carefully compared with the larva of *Arnoglossus megastoma*, a much closer resemblance will be found to this species than to any example of the genus *Trigla*. Thus the characteristic black chromatophores of the dorsal and ventral marginal fins, the slightly elliptical outline of the oil-globule in lateral view, the pre-anal marginal fin, and the shape of the head, all lean to the type indicated. My distinguished colleague at Marseilles will, I am sure, be the first to criticise his own interpretation when he is able to secure the ova of *Arnoglossus* and rear the larvæ; and also to contrast the larvæ of *Motella* with the unknown pleuronectid of the 24th February given in fig. 12 of his Pl. I. Few have any idea of the difficulties which observers at present encounter in their examination of such forms—difficulties to which I have already alluded in the opening paragraph of this report.

## 9. Additional Remarks on the Development of the Brill.

In last year's Report figures were given of the egg of the brill, (1) with the embryo just outlined, (2) of the egg shortly before hatching. The larva was also figured. These eggs, however, were all fertilised by the milt of a turbot, as no male brill could be procured. This year the attendant at the laboratory (A. W. Brown) forwarded, from Aberdeen, eggs of the brill fertilised by the male of its own species, so that an opportunity was given for revising the observations of last year.

The ova were procured off Aberdeen on the 22nd May 1892, and measured about 1·3335 mm., the oil-globule having a diameter of ·2286 mm. They thus agree closely with the Mediterranean examples, as well as with those obtained by Mr Holt on the West Coast of Ireland. Raffaele's diagnosis, therefore, of the eggs he met with in February and March in the Bay of Naples was correct, the pigment being very abundant in the larva. The size of these nearly corresponds, but those received from Montrose last year were larger (1·4097). It has to be remembered, however, that different micrometers and different microscopes were used. They reached the laboratory on the 24th, and at 11 a.m. the disc showed large spheres (Pl. XVI. fig. 14), which, however, may be due to irregularity or an abnormal condition, while the periblast around was studded with nuclei. The oil-globule behaved as in the gurnard, rolling under the periblast and beneath the disc, and passing through the yolk when suddenly inverted.

Next day (25th) the germinal cavity was apparent (Pl. XVI. fig. 15), and the disc covers a smaller area than in the specimen figured above. Around its margin are numerous cells and granules. The eggs are delicate, and if exposed in a small quantity of water in a cell for a short time perish, the protoplasmic covering of the yolk peeling off, shrinking on the embryo, and becoming opaque. On the 27th, at 11 a.m., the embryo had lenses, otocysts, and the tail projected from the yolk, while a yellowish hue pervaded the

head, body, and yolk-sac from the development of numerous chromatophores (Pl. XVI. fig. 16). So numerous are these over the yolk-sac that it seems to be densely spreckled all over with minute yellow grains. The majority of these chromatophores are still simple, only a few on the upper part of the yolk-sac being slightly stellate. Besides the yellow, the latter has many stellate black chromatophores. The latter, on the body, are for the most part simple. A few of both kinds occur under the oil-globule. There are numerous myotomes. Slight muscular movements of the body occur, and occasionally a trace of contraction in the heart. Somewhat later (3 p.m.) a considerable portion of the tail projected from the yolk, and Kupffer's vesicle appeared (Pl. XVI. fig. 17), the latter subsequently becoming considerably larger.

On the 28th the chromatophores on the body and yolk-sac have increased in size, the yellow still being simple and circular; whereas the black in most cases present a few ramifications. The embryos appear to be sickly—the heart being quiescent—the cold raw weather with an east wind probably depressing vitality. All the eggs lie on the bottom of the vessel. Kupffer's vesicle is still a single sphere. The tail has grown largely, and it is densely crowded with chromatophores. The yolk-sac is minutely vesicular from glands, as in the turbot and allied forms. The perivitelline space has increased, and the surface of the zona is corrugated.

Next day the yellowish pigment was still more distinct, and the black were finely ramose (Pl. XVI. fig. 18); indeed, the whole appearance of the embryo in the egg nearly corresponds with Professor Prince's sketch, so that the milt of the male turbot does not seem to have made any striking difference so far as can be seen in the embryo.

Raffaele's sketch of the larva appears to have been taken from a somewhat altered specimen, as indicated in last year's Report. In some very interesting remarks with figures on larval fishes made by Professor Marion since the foregoing was published, he alludes to a form procured on the 2nd March (Pl. II. fig. 20), which he thinks may probably be the young of *Trigla lineata?* So far as his very carefully made coloured figure, however, enables us to judge, it has a close resemblance to the larval brill, a species which M. Marion states is present in the Gulf of Marseilles, though by no means common. Moreover, a distinct pre-anal region of the marginal fin is present in M. Marion's figure, a condition which is not present in the species of gurnard studied at St Andrews, viz., *Trigla gurnardus*. M. Marion was struck by the remarkable coloration of the species, for, besides the brown, black, and reddish-orange of the head, body, and yolk-sac, two broad bars invade the dorsal, and one occurs in the ventral marginal fin. The first dorsal bar is nearly over the yolk-sac, the second forms a nearly symmetrical pair with the ventral, rather in front of the middle line of the caudal region (*i.e.*, from the rectum to the tip of the tail). It is possible the southern examples of the young brill are more brightly tinted than the northern. At any rate it would be well to re-investigate the subject, especially as no mention is made of the larval brill in Professor Marion's interesting observations, which form part of the finely illustrated series of papers from the Marine Laboratory at Marseilles, a series of papers which are a credit both to the Director of the Laboratory and to the Government which publishes them.

## 10. On an Egg resembling that of the Solenette in St Andrews Bay.

The excellent account of the eggs, larval, and early post-larval conditions

of the solenette (*Solea lutea*) by Mr Holt * leave little to supplement. He found the eggs abundant in the surface-nets in various bays on the west coast of Ireland in 1890, in the expedition under the Rev. W. Spotswood Green, one of H.M. Inspectors of Fisheries for Ireland. The same year several were procured in St Andrews Bay—one on 4th May, two on the 11th and one on the 30th July—all at the surface, and a sketch of one of these is given in Pl. XV. fig. 3, the oil-globules apparently being somewhat larger than in the Irish specimens, and the yolk-segments small. Mr Holt gives the diameter at from ·775 to ·835 mm.

On the 6th April this year (1892) an egg allied to the foregoing was procured in the bottom trawl-like tow-net in ten fathoms about three miles east from St Andrews, and another in the same (bottom) net on the 10th May. Both specimens were identical in structure (Pl. XV. fig. 4) and size, the diameter being ·7620 mm., or slightly smaller than those procured in the summer of 1890, or than those described by Mr Holt. The largest oil-globule is about ·004 mm. At first sight the capsule (zona) seems to be thick, but this appears to be due to the presence of a perivitelline space, which shows the wrinkles of the zona clearly, and also the micropyle. The fine lines and creases of the capsule faintly resemble those of the lemon-dab, but this may be due to immaturity or contraction of the egg; yet the same structure was present in both specimens. The oil-globules greatly exceed in number those of the ordinary egg of the solenette (Pl. XV. fig. 3), the latter figure showing all the oil-globules in the specimen—that is, both the deep-seated as well as those near the upper pole of the egg. Moreover, in the centre inferiorly, and therefore at the germinal pole of the egg, was a pale vesicle (?), considerably larger than any oil-globule, with a few granules and an oil-globule at its edge, this of course being of no particular moment as a special character. In the eggs of April and May, besides the much greater number of small oil-globules, the whole surface of the yolk is dotted with minute granules of oil, as indicated in the figure (Pl. XV. fig. 4). Mr Holt mentions that in his examples of the eggs of the solenette the oil-globules were restricted to the vegetative hemisphere, both in the early and advanced stages of the egg—a condition which differed from that in either of the eggs figured on Pl. XV., so that probably a change subsequently occurs. In the egg of April the yolk was invested by a conspicuous layer of protoplasm (*a*), which fixed the majority, if not the whole of the oil-globules, and which in a ruptured egg could be observed to peel from the yolk carrying the oil-globules in its folds. A similar belt of protoplasm is seen in the ordinary egg of the solenette in fig. 3; and as no trace of yolk-spheres occurred in the eggs of April and May, and only a few small ones in the last-mentioned figure, it may be that both are early stages, and perhaps those of April and May are unfertilised. The rarity of the latter condition, however, in pelagic eggs is well known. The occurrence of the example resembling the ordinary egg of the solenette at the surface, whereas the form alluded to here came from the bottom, is also a noteworthy point.

## 11. On an Unknown Pelagic Egg with a large Perivitelline Space and a single Oil-Globule.

On the 8th July 1891 an egg measuring ·0495 in., or 1·2573 mm., was procured in the bottom trawl-like tow-net in St Andrews Bay, amidst a

* *Trans. Roy. Dub. Soc.*, vol. iv., series ii., p. 460, pl. xlvii. figs. 9 and 10, and pl. lii. figs. 46–52.

profusion of eggs of the gurnard, sprat, rockling, &c. It was readily distinguished from the others by the presence of a considerable oil-globule—about ·009 in. or ·2286 mm.—and further, by the presence of a large perivitelline space (Pl. XIV. fig. 15). The yolk is simply granular, and thus differs from that of a clupeoid. A feature of moment is the occurrence of a distinct median furrow in the embryo. The posterior end, moreover, is peculiarly flattened out, with a corrugated region at the blastopore, and a granular shred projects from the margin of the latter into the perivitelline space. The embryo of *Corvina nigra* is similarly expanded posteriorly.*

The appearance of the egg next day (9th July) is shown in Pl. XIV. fig. 16. The head and eyes are more clearly defined, and the pectorals are distinct. Faint pigment-specks occur over the yolk and at the tip of the tail. These were still more evident the following day (Pl. XIV. fig. 17), while an opaque granular mass also stretches from the yolk to the left in the figure in front, and on the right posterior granular masses occur at the side of the embryo. These masses are apparently vesicular or perhaps fatty.

On the 10th July the canary-yellow pigment was distinct on the head, body, tail, and on the surface of the yolk. The chromatophores are simple rounded globules, no stellate processes having yet appeared. The oil-globule is almost colourless, or at most has a slightly smoky hue. It is fixed in the centre of the ventral surface of the yolk. The chief changes since the previous day are the more conspicuous condition of the pigment and the elongation of the tail. The cerebral vesicle is visible, and the otocyst is vesicular. Unfortunately the egg perished on the 13th before hatching, so that the nature of the larva could not be determined.

The presence of an oil-globule in eggs with a large perivitelline space is seen in the clupeoids, for example the pilchard, but in such cases the yolk is reticulated. On the other hand, the egg of the long rough dab, though it has a homogeneous yolk and a large perivitelline space, has no oil-globule. Mr Holt,† however, lately found a single example approaching the foregoing in the surface-net in Inver Bay, off the west coast of Ireland (Species VI.), and possessing a diameter of 1·13 mm., while the oil-globule had a diameter of ·21 mm. The yolk is clear and homogeneous, and pigment is absent at an advanced stage. The oil-globule is at the posterior end of the yolk. The specimen from St Andrews differs in size, in regard to the position of the oil-globule in the yolk, and in the appearance of pigment over the embryo at a somewhat early stage.

Amongst pelagic eggs of round fishes possessing an oil-globule not yet obtained at St Andrews are those of the bass (*Labrax lupus*), the mullets, greater weever, and hake (which has a large oil-globule), but the foregoing does not seem to be identical with any of these. Some pleuronectids, again, present a homogeneous yolk, while in others the yolk-surface is vesicular, and the turbot, brill, sail-fluke, and top-knot have a single oil-globule. The present egg, however, is larger than two of these, and moreover differs from all in having the spacious perivitelline space.

Raffaele found several eggs with a large perivitelline space in autumn, but was unable to identify them. In these, however, the yolk was reticulate, and the oil-globule tinted yellowish.

### 12. On the Eggs of the Frog-Fish (*Lophius*).

For many years the ova of this species have been carefully looked for at St Andrews, for the species was formerly abundant in the bay, yet in no instance has a mass of spawn or even a single egg been obtained by

* Raffaele, *Mittheilungen Zool. Stat. Neap.*, viii., sep. copy, p. 26.
† *Trans. Roy. Dub. Soc.*, vol. iv. p. 469, pl. xlviii. fig. 17.

the nets from the Laboratory. It would, therefore, seem that adults in a ripe condition are rare within the limits of the bay, and probably are found chiefly in the offshore grounds. The persistent slaughter of this form by trawlers and stake-net fishermen, who see in it only an enemy to the ordinary food-fishes, may in recent years have somewhat diminished its numbers.

On the 10th July 1891, a considerable portion of the gelatinous mass containing the ova was found in a stake-net off the East Rocks,* having apparently been swept in by currents and entangled in the meshes. Its nature being misunderstood (it was supposed to be a kind of jelly-fish), the mass had been thrown on the bottom of the boat, and was considerably injured. The gelatinous ribbon forms hexagonal, pentagonal, curved or irregular spaces in which the large eggs lie. It is perfectly transparent, and its disposition on the surface and in the intermediate partitions gives a somewhat areolar arrangement. Moreover, on its surface are numerous apertures for the ingress and egress of water. The septa are invisible, unless the gelatinous stroma be injured.

The contained ova had a diameter about 2·2860 mm., and the large oil-globule ·5334 mm., its colour being pinkish-brown or smoky (like honey). The description of the eggs and embryos will be given by Prof. Prince, in whose hands they were placed. The foregoing note is made only in connection with the occurrence of a single free egg in the tow-net of the 'Garland' in St Andrews Bay, on the 3rd July 1891, amongst a considerable collection of the eggs of other forms. This appears to be a comparatively rare feature, though in the present case it can readily be explained by the breaking up of the gelatinous ribbon amongst the rocks, by the salmon stake-nets, crab-pot lines, or other obstacles. A week later the ribbon above alluded to was secured by the salmon-fishermen.

This isolated pelagic egg, after preservation, is somewhat ovoid, its long diameter being 1·6764 mm., and the shorter 1·6383 mm., but the contained embryo, which was far advanced (Pl. XIV. fig. 12), may have modified the outline to some extent. The oil-globule, which now has a diameter of about ·3048 mm., is situated slightly to the left of the middle line, rather behind the middle of the yolk, and is surrounded by black pigment (Pl. XIV. fig. 13). The embryo is more than half round the yolk, and the tail is carried to the left. Blackish (stellate) pigment is present in large patches and streaks on the head and along the sides of the body, as shown in the sketch (*Ibid.*, fig. 12). The yolk, as usual in such cases, has an orange hue.

There are few eggs with which the foregoing can be confounded, if indeed any. Only five species of 2 mm. in diameter and upwards are mentioned by Raffaele, and all are unknown. Without going into detail, the structure of every one diverges characteristically from the foregoing.

## 13. On an Abnormal Plaice.

Ichthyologists are familiar with the continuation of the dorsal and anal fins on the right side—for instance, in Müller's topknot—but this condition is unknown as a normal character in the plaice and other members of the genus Pleuronectes of Artedi.

In March 1891, a liner, named James Gourlay, who has from the first most cordially helped in Fisheries' work, secured a peculiar plaice about 8 inches in length and about 4¼ inches broad. The right surface presents a fairly normal appearance, except that near the caudal an irregularity of

* The courtesy of Mr Turbyne, the lessee of the salmon fishings, on this and other occasions, merits my best acknowledgments.

the fin-rays—both dorsal and anal—occurs. This irregularity is due to the occurrence in the ordinary series of a few irregular fin-rays at a different level from the rest (lower when the fish is placed on a flat surface, right side up).

On the left side (Pl. XVII. fig. 5), the lateral line posteriorly is curved gently to the dorsal side, and terminates, after a short course, about half an inch in front of a somewhat elevated border stretching from the interspinous region of the dorsal to the interspinous region of the anal. This elevated border is fringed with a continuous series of rays. The first of the irregular series ventrally pass from the anal interspinous bones at a forward angle, and the transverse rays follow in order, as observed in the sketch. The rays joining the dorsal are crowded, and form almost a double series at the prominent fold of the region. The interspinous elements show a tendency—both at the dorsal and the ventral edge—to follow the abnormal transverse or vertical fin, but they seem to be deficient in the central region, though slight folds are visible.

The lateral line commences anew from the centre of the transverse or vertical fold formerly alluded to, and goes straight backward as usual to the caudal. Behind the irregular region a small portion of the dorsal and anal fins, of a normal structure, existed on each side of the terminal caudal trunk, and at both edges the fin proceeded somewhat further backward than usual.

The left side is of the normal colour, with the exception of a circular patch of black about $\frac{1}{4}$ of an inch in diameter, which is situated below the lateral line, and almost covered by the membrane and rays of the abnormal vertical fin. Above the lateral line, again, is another minute black speck.

## 14. Further Remarks on Injuries to Food-Fishes on the Lines.

1. *Cuttle-Fishes.*—In the Fourth Annual Report of the Board (1885), reference was made * to the injuries inflicted by the squids on the haddock, whiting, and bib after they are hooked. During a period extending over a fortnight, towards the end of November (1891), cuttle-fishes were unusually abundant off the mouth of the Forth, between the Bell Rock and the Island of May, and over an area ten miles east and west. Daily, during this period, the fishes (codling, haddock, and whiting) on the hooks were more or less injured, each boat having about a box of fishes that had been attacked, and which were only of use for the crab-pots. The fishermen do not remember seeing them in such numbers, and so bold in their habits. They often held on to the fishes till they were at the surface, and then swam off actively, so that a ring-net was necessary for their capture. The most abundant form was *Loligo Forbesii*, though *Eledone* was also present. As formerly indicated, the wounds were generally situated behind the head, large gaps extending occasionally three or four inches backward, and in some the brain was removed. In those most injured the gaping dorsal wound opened into the abdominal cavity—from which the liver was almost invariably removed, while the stomach and intestine were untouched—a feature so familiar in the attacks of other predaceous forms, both marine and aerial. The massive muscles along the dorso-lateral region are gouged very neatly out by rasping, but shreds of skin hung here and there to the margins of the wounds.

2. *Star-fishes.*—In the same Report of the Board a note was also made on the injuries caused by star-fishes, as follows:—'Moreover, if the lines 'have been long down, as for instance for a night or two during a storm, 'the fishes are so injured (the fishermen say "sucked") by the cross-

* Page 204.

'fishes that some resemble those removed from the stomach of a predatory fish.' Star-fishes are extremely abundant near the Carr rocks, and lines left from Saturday till Monday presented a considerable number of injured fishes. The large haddocks (about 5 lbs.) were unsightly and the skin 'sodden,' and in a few rupture of the cornea had occurred, though of course the latter injury might have been caused by another species, for instance the great whelk (*Buccinum*). If such fishes had been submitted for examination without remark, various interpretations might have been advanced, some of them perhaps exceedingly wide of the mark.

## 15. List of Some of the Pelagic Ova, Larvæ, and Young Fishes obtained by the 'Garland' in 1891 and 1892, with Remarks.*

The collections of pelagic eggs and larval fishes made by Mr Scott, F.L.S., in the 'Garland,' greatly exceed those of former years; indeed, the number has, at least, been doubled, a proof of the conscientious care and continued activity devoted to this department. The labour involved in going over these collections is serious, and the question naturally arises as to the value of the observations resulting therefrom. In the first place, much depends on the manner of preparing the eggs, for those with ruptured yolk and dissolved oil-globules, in many cases, lead only to confusion, while the variations in contraction, caused by the alterations in the strength or composition of the preservative fluid, still further complicate the subject. Further, an improper mode of killing the ova, even when the preservative fluid is satisfactory, results in irremediable opacity. Even years of experience in dealing with such specimens—both living and preserved—cannot, in all cases, enable the observer, after the expenditure of much time, to feel satisfaction with his labours.

Irrespective of the differences caused by the varied action of the preservative fluids in the same species of pelagic egg, those ambiguities due to the close approach in size of forms, perhaps widely divergent, have to be encountered. Thus, badly preserved eggs of the flounder and dab, of the whiting, poor-cod and sprat, of the cod, lemon dab and bib, of the ling and turbot, and of the gurnard, brill, and megrim entail considerable trouble in discrimination, and often with unsatisfactory results. Nor is it necessary to refer to such possible accidents as the retention in the tow-nets (it may be for many hours in the open air) of part of the eggs of a previous collection, and their subsequent admixture with a fresh series.

The presence or absence of an oil-globule is a ready means of distinguishing certain forms, but the addition of a fluid, containing too large a proportion of spirit, renders such indistinct or invisible. In the same way the vesicular yolk of the sprat is rendered opaque, and even the characteristically thin capsule and the size cannot always be depended on.

The structure of the capsule (*zona radiata*) itself, it is true, renders the identification of some pelagic eggs comparatively easy. Thus the eggs of the dragonet and the unknown egg (2 mm. in diameter), found by Wenckebach in the Bay of Naples, are at once recognised by their reticulated capsule, and the present Report will show that the capsule of the eggs of the torsk may also be easily diagnosed.

Though the number of the pelagic eggs is considerable at various stations, it may, nevertheless, be asked what are all the ova thus collected in tow-nets to the vast multitudes in the inshore or offshore waters and in the open ocean, or to the product of a single female of one of the larger food-fishes? There cannot be a doubt that the pelagic nature of such eggs

* I am indebted to Mr W. E. Collinge, a student of this University, for patiently separating and calculating the ova from most of the Stations.

is intimately associated with the almost undiminished prosperity of the marine fisheries, notwithstanding the vast increase of men, boats, and apparatus.

Besides the pelagic eggs of fishes, many pelagic eggs of a Crustacean and of a Medusoid (?) occurred in April in St Andrews Bay.

Generally speaking, the bottom trawl-like tow-nets, or other tow-nets, used on the bottom gave the largest number of ova, and, besides, they are most productive of fishes, and these at a more advanced stage.

So far as present experience goes, the degree of development of the several collections affords only a limited amount of information in regard to distribution, for the distance travelled is unknown, and the temperature of the water is uncertain. Besides, the case is wholly different from that in which a given species spawns within a limited time. Here the spawning period of most forms is prolonged—even in the case of single individuals, though, of course, much more in regard to successive individuals of each species. The eggs captured beyond the Island of May do not show, in any marked manner, different stages from those procured at the stations near Inchkeith. That many ova from the offshore waters are carried into the sheltered bays goes without saying, and was fully pointed out in the Trawling Report, but we cannot yet draw data of moment from the degree of development of these pelagic eggs. The migration of the young fishes is likewise an important factor. Thus, the young ling seek the rocky margins in their barred condition; the young cod, green cod, and pollack the pools and the laminarian forests in the same regions; and the turbot and brill the border of low water or sandy beaches at an early period of their lives; whereas the adult ling, cod, and other forms are met with, as a rule, in greatest numbers in the open waters.

That this profusion of the pelagic eggs of fishes, in a given area of the ocean, is diagnostic of the abundance of their parents in that region, was sufficiently apparent in the Trawling Expeditions of 1884, for instance, by contrasting the tow-nets south-east of the Island of May with those in St Andrews Bay, or by contrasting those from Smith Bank with those in Aberdeen Bay. The vast masses of the ova of the cod that occur in Norwegian waters, and which are occasionally beached in long lines—just as the bulky masses of the translucent salpæ were on the shores of Lochmaddy in 1865—is another example. These indications are fairly accurate indications of the finny population of the waters at the particular time, yet it must be remembered that the pelagic eggs of fishes, for example, in St Andrews Bay, give no clue to the multitude of young plaice which are harboured there, and probably have been harboured there from time immemorial, and whose numbers have hitherto defied the persistent efforts of both liners and trawlers; and, further, whose numbers seem to to be almost independent of legislative measures within territorial waters. Again, no trace of the large pelagic egg of the halibut has ever been seen in the tow-nets, so often used either on the great fishing banks, as in the trawling work of 1884, and since that date, in the regular work of the 'Garland,' or in the boats of the Laboratory; yet young halibut of small size (about a foot) are occasionally found in St Andrews Bay and elsewhere, in inshore waters. This would raise a doubt as to whether the action of currents on the pelagic ova altogether suffice for the distribution of the common food-fishes. Again, if we are right in supposing the egg of the halibut to be pelagic, it may yet be one that floats deeply in the water. In connection with the halibut, a remark may be made here as to the extraordinary numbers of this huge species which are landed yearly on the pontoon at Grimsby; indeed, the array of these fishes forms one of the most striking features of that remarkable fishing centre. A single vessel from Iceland

or Faroe will land from 5 to 700 of them, the majority packed in ice, though a few of the finest are brought to port alive—fastened, or rather slung, head downward in the well of the ship by a clove-hitch round the tail, each being thus marked by a deep ulcer (from the ligature) round the tail; that organ itself being often so congested as to resemble a red flag, and occasionally the ligature cuts right through. The larger are also frequently marked by the wound of the gaff used in getting them on board. The halibut is also one of the forms which illustrates the large proportion of the immature in ordinary captures (by lines), many ranging from 16 to 18 inches to 2 or 3 feet.

In the enumeration of the various kinds in the several collections it must be distinctly understood that the figures are only approximative, since—apart from the changes due to contraction—it is likely that eggs closely resembling each other in size have been grouped together, *e.g.*, those of the gurnard, the brill, and Müller's topknot, the cod, green cod, and pollack.

It is interesting to watch the succession of the various eggs throughout the year, but this subject is so extensive that a special report would be necessary to do it justice. Some extend over a long period, like those of the rocklings and gurnards, while others occur chiefly in the warmer months like those of the dragonet and sole.

In former years the pelagic eggs were chiefly preserved in strong methylated spirit, no special method having been adopted in killing them. This had one merit, viz., a uniform degree of contraction in all the collections thus made, but it rendered the oil-globule in such eggs as possessed such more or less invisible, while the pigment of the advanced embryos, and the outlines of the embryos themselves were indistinct. The yolk, of course, was densely opaque.

Recently various experiments have been made at the Laboratory by Mr Collinge and myself with a view to find out a good method of preserving these ova, so as to ensure the best possible results in relation to contraction, transparency, permanence of the oil-globule, and the condition of the embryo. These are not yet completed, but it may be well to make a few preliminary remarks so as to enlist attention to the subject. As a rule the ova which are preserved for the present purposes (viz., identification of the species in connection with their distribution), are killed by adding a few drops (in a watch-glass or small beaker) of a saturated solution of picric acid in 5 per cent. hydrochloric acid to an ounce of water. They should then be carefully washed in fresh water. If allowed to remain longer than three minutes, or where there was too large a proportion of the acid, the condition of the yolk was unsatisfactory. Those killed in a saturated solution of corrosive sublimate (6 parts to 3 parts of glacial acetic acid), were less satisfactory.

The ova were then preserved in the following solutions:—

| | |
|---|---|
| Picro-sulphuric (Kleinenberg's), . . . | 2 parts. |
| Methylated spirit, . . . . . | 2 „ |
| 2 per cent. acetic acid, . . . . | 1 „ |

In this fluid shrinkage was comparatively small, and the oil-globule in the eggs of the rockling and gurnard were well preserved. The yolk was opaque. In picro-sulphuric acid 1 part and 2 per cent. acetic acid, the oil-globule remained in good condition, the contraction was slight, but the yolk was distorted, and the perivitelline space filled with an opaque fluid. The eggs experimented with, however, were ovarian (gurnard's).

Shrinkage was great, the yolk opaque and distorted in those placed in picro-sulphuric acid 2 parts, glycerine 1 part, and 60 per cent. alcohol 2 parts.

Very satisfactory results were obtained by the use of a fluid composed

of a saturated solution of picric acid 1 part, methylated spirit (undiluted) 1 part, 2 per cent. acetic acid 1 part. The oil-globule always remained clear, and the shrinkage was moderate. Moreover, Mr Collinge found that ova badly preserved may be transferred to this with advantage, especially where the oil-globule is indistinct.

Ova preserved in methylated spirit 4 parts, spirit of camphor 1 part, 2 per cent. acetic acid 4 parts, shrank considerably, but their condition otherwise was satisfactory.

In Perenyi's fluid 1 part, and 50 per cent. alcohol 4 parts, the ova assumed a bluish tint, and shrank considerably, but the oil-globule was clearly visible, and the embryo and its pigment were well seen.

When dead eggs of whiting and poor cod were simply placed in 2 per cent. acetic acid they looked well for a day or two, but soon they began to swell, and the yolk was disintegrated. In other cases (living rockling), both pigment and oil-globule were preserved, but the yolk was somewhat collapsed.

In 50 per cent. spirit the shrinkage was moderate, the oil-globule was visible for weeks, and the results fairly satisfactory.

In equal parts of picric acid and 50 per cent. spirit, the eggs shrank moderately, and the embryo and its pigment were well seen.

In picric acid 2 parts and methylated spirit 1 part, the contraction was considerable, and by it the oil-globule disappeared, and the yolk was disrupted.

In picric acid 1 part, spirit 1 part, the shrinkage was as usual, but the oil-globule was visible in many, though small.

When placed in a fluid composed of acetic acid 2 parts, spirit of camphor 1 part, the oil-globule remained very distinct, and the embryo and its black pigment were clearly shown. The contraction was moderate.

If any method could be discovered whereby the colours as well as the tissues of the larvæ could be adequately preserved, a very great impulse would be given to the elucidation of the life-histories of the food-fishes. At present black pigment alone seems to resist the preservative fluids, and the power of rapidly making a coloured sketch, such as Professor Prince and Mr Holt possess, is an exceptional gift.

In regard to the larval and post-larval fishes the observations of many years show that no forms are more abundant and more generally distributed than the sand-eels and clupeoids. The former are plentiful, both in inshore and offshore waters, the protracted spawning period giving larval and post-larval forms from the earlier months of the year till autumn. A continuous supply is thus provided for the varied wants of the more valuable food-fishes. The pelagic habits of the young sand-eels still further render them suitable for this function. The clupeoids likewise are extremely abundant, often indeed, as on certain occasions in March, so clogging the bottom-nets that their use had to be discontinued for a time. Nevertheless—though two well-marked spawning periods occur—their importance as food for the younger fishes would not seem to be much greater than that of the sand-eels.

Larval gadoids abound in the spring months — especially in April, and the same may be said of the pleuronectids. The turbot and sole, however, are later. Young gobies, again, are very abundant in the bottom-nets during the warmer months, and like the young eels are to be found far up the estuary of the Forth in autumn. Young pipe-fishes abound off the estuary of the Eden.

Larval and post-larval fishes are best killed in the usual solution of corrosive sublimate, well washed, and then placed in weak spirit for some hours. They may be transferred by stages to strong spirit. There is,

however, no objection to their being placed at once (after being killed with the sublimate) in strong methylated spirit.

## I. MONTROSE.

Station I.—Bottom, 28th August 1891. Young clupeoids (herrings), 6 to 7 mm.; dragonet, 3·5 mm.

Station II.—Bottom, 28th August 1891. Young clupeoids (herrings), 6 to 10·5 mm.; pleuronectid, 9 mm. The herrings belong to the autumn-brood.

## II. MORAY FIRTH.

Station IV.—Bottom, 9th September 1891. Young bimaculated suckers, 4·8 to 9 mm.; young gobies, 3·5 to 7·5 mm.

Station V.—Bottom, 9th September 1891. Large post-larval pleuronectid 7·5 m.m. long, with black patch near tip of tail, and two between this and anus; gobies, 6·5 to 9 mm.; young bimaculated suckers, 4·8 to 8 mm.

Station VI.—Bottom, 9th September 1891. Bimaculated suckers, 5·5 to 11 mm.; sinistral pleuronectid, 4 mm,

## III. FIRTH OF FORTH AND OFF THE ISLAND OF MAY.

South Bay.—Bottom, 31st March 1891. Two herrings, 7 to 8 mm., yolk-sac absorbed; three armed bullheads, 6 to 8 mm.; two Montagu's suckers, 4 mm.

Station III.—Surface and bottom, 27th May 1891. Young dabs (?) 12·5 mm., left eye partly over the ridge; young sand-eels 8 to 9 mm.

Station I., (vicinity of).—Surface, 8th June 1891. Moderate collection of eggs. 29 eggs of gurnard, embryos more than ½ round yolk; sprat, 1158, embryos about ¾ round yolk; about 50 eggs of dab in similar condition; 46 eggs of rockling (two species); 1 egg of dragonet; 14 pleuronectids (imperfectly preserved), from 9 to 11 mm., those about 9 mm. being elongated, with the left eye more or less on its own side, though visible in some from the right. One of the larger is a dab, the others probably flounders and plaice (?).

Island of May.—Surface, 9th June, 1891. 45 eggs of gurnard; 181 eggs of sprat; many eggs (about 50) resembling those of top-knot, and some smaller like turbot; 110 eggs of rockling.

Around Island of May.—Surface, 9th June 1891. Moderate collection of ova. Eggs of gurnard (many); considerable number of eggs of sprat; poor-cod; whiting(?); and two kinds of rockling, embryos about ½ round the yolk.

Around Island of May.—Tow-net at 6 to 8 fathoms, 9th June 1891. Dabs, 8 to 12 mm., eye appearing on ridge; gurnard, 27 mm.

West of Island of May.—Surface, 9th June 1891. Considerable collection of ova. Many eggs of gurnard; whiting(?); poor-cod; considerable number of eggs of sprat; many eggs of rockling as before.

Station I., (vicinity of).—Surface, 11th June 1891. Very considerable collection of ova. 24 eggs of gurnard; about 3005 eggs of sprat and dab, about 100 being eggs resembling those of the dab; 649 eggs of rockling as before; 6 eggs of dragonet.

Station I., (vicinity of).—Surface, 11th June 1891. Considerable collection of ova; 65 eggs of gurnard, embryo ½ round the yolk; 1184 eggs of sprat and dab, about 80 being near dab; 403 eggs of rockling.

Station II.—Surface, 12th June 1891. Large number of pelagic eggs.

23 eggs of gurnard (one resembling topknot); 3778 eggs of sprat, with a few of dab and poor-cod; 176 eggs of rockling as before; 8 eggs of dragonet, two showing indications of a small oil-globule, probably from change in yolk, due to preparation. The preservative fluid had not acted satisfactorily.

Station I.—Surface, 22nd June 1891. 148 eggs of gurnard, embryo fully $\frac{2}{3}$ round yolk, rest injured in preservation; 2875 eggs of sprat, with an admixture of forms like dab and poor-cod;* 81 eggs of rockling as before.

Near Alloa.—Bottom, 7th July 1891. Sprat 32 mm.; numerous gobies 4·8 to 17·5 mm.

West of Queensferry.—Bottom, 7th July 1891. Young pleuronectid (dab or flounder) 7 mm.; young gobies 9 to 22·5 mm.

Largo Bay.—Surface, 8th July 1891. Small collection of ova; 34 eggs of gurnard; considerable number of eggs of turbot-like form; 57 eggs of sprat, some nearly ready to hatch; 153 eggs of rockling as before.

Pleuronectid 12 mm., left eye on ridge, and towards right side, which is chiefly pigmented, though pigment still remains on left side, arranged like that on right.

Kirkcaldy Bay.—Surface, 8th July 1891. About 20 eggs of gurnard, embryos about $\frac{2}{3}$ round the yolk; 125 eggs of sprat and dab-like form, embryo from $\frac{4}{5}$ round yolk to nearly ready to hatch; considerable number of eggs of rockling, embryo $\frac{2}{3}$ round yolk; young dab (?), 8 mm., left eye appearing over ridge.

Kirkcaldy Bay.—Bottom, 8th July 1891. Pleuronectid 10 mm., left eye advanced and approaching ridge.

Station V.—Surface, 9th July 1891. Young rockling, 28 mm. (mackerel midge); pleuronectid, 11 mm., eye appearing over ridge.

Station V.—Bottom, 9th July 1891. 73 eggs of gurnard, embryo about $\frac{4}{5}$ round yolk; 113 eggs of rockling (two species), embryo $\frac{2}{3}$ round yolk; a few resembling turbot and topknot, embryo about $\frac{2}{3}$ round yolk.

Station V.—Twelve fathoms tow-net, 9th July 1891. Young clupeoids, 16 to 18 mm.; young rocklings, 3·5 mm.; post-larval sprats, 5·3 to 6·8 mm.; young dragonets, 3·2 mm.; pleuronectids, 3·5 to 7 mm.

Station V., (vicinity of).—Twelve fathoms tow-net at midday. 11 eggs of gurnard, embryo $\frac{4}{5}$ round yolk; a few eggs of sprat; 62 eggs of rockling, embryo almost encircling yolk; 13 eggs of turbot-like form, embryo $\frac{2}{3}$ round yolk.

Station V., (vicinity of).—Bottom, 9th July 1891. A comparatively large collection of ova. 531 eggs of gurnard, embryo $\frac{2}{3}$ round yolk; 97 eggs of sprat, with a few poor-cod and a turbot-like form; 419 eggs of rockling (two species), embryo $\frac{2}{3}$ round yolk and even further advanced.

Fidra to Cockenzie.—Surface, 9th July 1891. A smaller collection than at bottom; 48 eggs of gurnard, embryo from $\frac{1}{2}$ to $\frac{2}{3}$ round yolk; 3 eggs of weever; 45 eggs of sprat, embryo $\frac{1}{2}$ round yolk; 21 eggs of rockling, embryo $\frac{1}{2}$ round yolk; 2 eggs of dragonet; young lump-suckers, 9 to 16·5 mm. (probably amongst floating sea-weeds).

Fidra to Cockenzie.—Bottom, 9th July 1891. Moderate collection. About 20 eggs of gurnard; 200 eggs of sprat; and about 50 of pleuronectid; 58 eggs of rockling as before; 2 eggs of dragonet.

Gullaneness to Kinghornness.—Bottom, 10th July 1891. 1 egg of gurnard; 386 eggs of sprat, embryo $\frac{4}{5}$ round yolk, and in some nearly ready to hatch; 128 eggs of rockling, embryos $\frac{4}{5}$ round yolk; post-larval dragonet 3 mm.; post-larval goby 3 mm.

* Preservation rendered diagnosis imperfect.

South Bay.—Surface, young lump-suckers 10 to 14 mm.

Station IV.—Surface, 17th July 1891. A few eggs of gurnard; 750 eggs, chiefly of sprat, embryo at various stages, some $\frac{3}{4}$ round yolk; 48 eggs of rockling, embryo at various stages; 30 eggs of dragonet, embryo from early formation to $\frac{3}{8}$ round yolk.

Station V.—Surface, 17th July 1892. 140 eggs of gurnard; 90–100 eggs of sprat; 1083 eggs of rockling, embryo $\frac{3}{8}$ round yolk.

Station III.—Surface, 18th July 1891. 6 eggs of gurnard; 445 eggs, chiefly of sprat; 89 eggs of rockling.

Station V.—Bottom. Gadoids 6 to 8 mm.; many rockling 4 mm.; many pleuronectids 7 mm., eyes lateral; gobies 5 mm.; pelagic egg 1·2192 mm., embryo half round yolk.

Station VIII.—Surface, 21st July 1891. 340 eggs of gurnard, embryo $\frac{1}{2}$ to $\frac{3}{4}$ round yolk; 714 eggs of rockling (two forms), embryo in most about $\frac{1}{2}$ round yolk.

Station VIII.—Bottom, 21st July 1891. Gobies 3·5 to 4·5 mm.; *Cotti* 5·2 mm.; Montagu's sucker 4·5 mm.

Station IX.—Surface, 21st July 1891. Eggs of gurnard, embryos at various stages, chiefly advanced; 209 eggs, chiefly of sprat, embryos fully $\frac{1}{2}$ round yolk; 310 eggs of rockling, embryos about $\frac{1}{2}$ round yolk.

Station IX.—Bottom, 21st July 1891. Montagu's sucker 4 mm.; gobies 3·2 to 4·5 mm.; pleuronectids 5 to 7 mm.

Station V.—Surface, 22nd July 1891. Moderate collection of ova. Eggs of sprat, dab (?), turbot, rockling (two forms), gurnard, and larva of rockling (probably *M. tricirrata*).

East of Inchkeith.—Surface, 28th July 1891. 17 eggs of gurnard, embryo about $\frac{1}{2}$ round yolk; eggs of lemon-dab (?); 613 eggs of sprat, embryo $\frac{4}{5}$ round yolk; 75 eggs of rockling, embryo $\frac{1}{2}$ to $\frac{3}{4}$ round yolk.

West of Island of May, Mid-Channel.—Surface, 1st haul, 31st July 1891. Comparatively few ova; 48 eggs of gurnard, embryo in some $\frac{1}{2}$ round yolk, rest indistinct; 30 eggs of sprat, $\frac{1}{2}$ round yolk; young sand-eels 9 to 11 mm.; young clupeoids 16 mm.; young rocklings 4 to 5 mm.; young goby 7 mm.; pleuronectids 7·5 to 10 mm. (like long-rough dab ?), eyes symmetrical; 3 of rockling.

West of Island of May, Mid-Channel.—Surface, 2nd haul, 31st July 1891. Comparatively few ova; 197 eggs of gurnard, embryo $\frac{3}{8}$ round yolk; 63 eggs of sprat, embryo $\frac{4}{5}$ round yolk; 23 eggs of rockling, embryo $\frac{1}{2}$ round yolk; young clupeoids 8 to 11 mm.; a larger series from 15 to 17 mm. (probably sprats), and others 21 mm., evidently older; post-larval pleuronectids (lemon-dabs ?) 5 mm., with three black pigment-bars behind vent; post-larval pleuronectids 10 mm.; young rockling 4·5 mm.; post-larval dragonets 4·5 to 7 mm.

West of Island of May, Mid-Channel.—Bottom, 1st haul, 31st July 1891. Clupeoid 21 mm.; gobies 5 to 8 mm.; pleuronectids 8 to 10 mm., eyes lateral.

West of Island of May, Mid-Channel.—Bottom, 2nd haul, 31st July 1891. Comparatively few ova; 57 eggs of gurnard, embryo $\frac{1}{2}$ to $\frac{3}{8}$ round yolk; 71 eggs of sprat, embryo from $\frac{3}{8}$ to $\frac{4}{5}$ round yolk; 38 eggs of rockling, as before, embryo $\frac{1}{2}$ round yolk.

East of Island of May.—Surface, 31st July 1891. 41 eggs of gurnard, embryo $\frac{3}{8}$ round yolk; 35 eggs of sprat, embryo from $\frac{4}{5}$ to complete environment of yolk; a few eggs of rockling; egg ·8382 mm.

East of Island of May, $3\frac{1}{2}$ Miles.—Tow-net at 12 fathoms, 31st July 1891. Clupeoids (sprats ?) 5·5 to 9 mm.; rockling (injured) 3 mm.; gobies 5 to 7 mm.; pleuronectids 4·5 to 8 mm.

Beamer to Bo'ness.—Bottom, 3rd August 1891. Numerous young

gobies 5 to 21 mm.; young dragonet 4 mm. In former days the 'great' lines were used in this region for cod, which pursued the herrings up the Forth.

ANNAT TO ALLOA.—Bottom, 3rd August 1891. Young gobies 3·8 to 18 mm. Sagittæ, Mysidæ, and other forms occur in great numbers.

ELIE TO CRAIL.—Surface, 4th August 1891. Comparatively small collection of ova. About 95 eggs of gurnard and allies, embryo $\frac{4}{5}$ round yolk; 141 eggs of sprat, embryo $\frac{4}{5}$ round yolk; 222 eggs of rockling, embryo $\frac{4}{5}$ to complete environment of yolk.

ELIE TO CRAIL.—Bottom, 4th August 1891. Post-larval pleuronectids 5·5 to 8 mm. (dabs ?); rockling 3·5 to 4 mm.; gobies 4·5 to 7 mm.; tentacle of medusa (*Cyanea ?*).

STATION VII.—Surface, 6th August 1891. 84 eggs of gurnard, embryo $\frac{3}{5}$ round and completely round yolk; 35 eggs of sprat, embryo $\frac{1}{2}$ to $\frac{2}{3}$ round yolk; 267 eggs of rockling (two forms), embryo $\frac{2}{3}$ round yolk.

STATION VII.—Bottom, 6th August 1891. Gobies 3 to 6 mm.; 2 sand-eels 6·5 mm.; 2 pleuronectids 5·5 mm.; rockling 5·2 mm., with silvery abdomen and long ventrals.

STATION I.—? Surface, 14th August 1891. Small collection of ova; 3 eggs of gurnard, embryo about $\frac{1}{2}$ round yolk; 68 eggs, chiefly of sprat, embryo about $\frac{2}{3}$ round yolk; 102 eggs of rockling, embryo about $\frac{1}{2}$ round yolk.

STATION I.—Bottom, 14th August 1891. 30 gobies 3·2 to 8·5 mm.; 1 near the foregoing (?) 5 mm.; 4 pleuronectids 5 to 6 mm.; 1 post-larval dragonet 5·5 mm.; 1 Montagu's (?) sucker 4 mm.

STATION III.—Surface, 17th August 1891. Very small collection of ova; 4 eggs of gurnard; 1 egg of sprat; 1 egg of rockling.

STATION VII.—Bottom, 17th August 1891. 11 gobies 3·3 to 5·5 mm.; 9 pleuronectids 4 to 9·5 mm., latter with eyes symmetrical in one, and another with left eye appearing on ridge; Montagu's (?) sucker 4·5 to 6 mm.

STATION V.—Surface, 18th August 1891. Similar number of ova to the foregoing; eggs of gurnard, embryo fully $\frac{1}{2}$ round yolk; eggs of sprat, embryo about $\frac{3}{4}$ round yolk.

STATION V.—Bottom, 18th August 1891. Post-larval pleuronectids 8·8 mm.; gobies 4 to 9 mm.; Montagu's sucker 4 mm.

STATION VIII.—Bottom, 18th August 1891. 4 gobies 4 to 9 mm.; 1 Montagu's sucker 4·5 mm.; 1 pleuronectid 7·5 mm.

STATION IX.—Surface, 19th August 1891. Very few ova. Seven eggs of gurnard, embryo encircling yolk, and in some nearly ready to hatch; 5 eggs of sprat embryos, half round; 21 eggs of rockling, embryos from $\frac{4}{5}$ths round to completely round yolk.

STATION VI.—Bottom, 19th August 1891. Four post-larval pleuronectids, 4·5 to 8·5 mm., youngest boldly pigmented; 24 gobies, 4·5 to 8·5 mm.

OFF ELIE, NEAR MID-CHANNEL. Tow-net at 12 fathoms, 21st August 1891. Seven post-larval pleuronectids, 4·5 mm. (with notochordal whip) to 6·5 mm., with the right eye just visible on the ridge, and probably including dabs, lemon-dab, and a sinistral form; 2 young rocklings, 3·5 to 4 mm.; 4 gobies, 5·5 to 6 mm.; dragonets, 3 to 6 mm.

STATION V.—Bottom, 1st October 1891. Young whiting, 19 mm.; clupeoids, 15 to 18 mm.; young gobies, 6 to 16 mm.; bimaculated suckers, 7 to 10 mm.; *Cotti*, 3·5 to 8·5 mm.; dragonet, 5·5 mm.; lemon-dab, 10·5 mm.

BETWEEN STATIONS III. AND IV., CROSS-SECTION.—Bottom, 7th October 1891. Young clupeoids (herrings), 14 to 19 mm.

BETWEEN THE ISLAND OF MAY AND THE BASS ROCK.—Bottom, 8th October 1891. Young clupeoids (herrings), 17 to 22·5 mm.; greater pipe-fish, 47 mm.; young goby, 12 mm.

NEAR MIKRA STONE.—Bottom? New stationary net, 10th October 1891. Young dab, 12 mm.; and *Ammotrypane aulogaster*, a sand and mud-loving annelid.

OXCAR TO 'ROOST,' NEAR INCHKEITH.—Bottom, 15th October 1891 Clupeoids (herrings), 17 mm.; rockling, 3·8 mm.; unknown form near *Cottus*, 6 mm. (eyes larger than in *Callionymus*).

FROM N. ROUND BY E. TO S. END OF INCHKEITH.—Bottom, 15th October 1891. Clupeoids (herrings), 16 to 17 mm.; rocklings, 3·6 to 6 mm.

STATION III.—Bottom, 19th October 1891. Young clupeoids, 18–22 mm.; gobies, 8 to 18 mm.; *Cotti*, 5 to 8 mm. Mingled with an enormous quantity of Sagittæ.

STATION VIII.—Bottom, 25th October 1891. Clupeoids, 21–22 mm.; lemon-dab (?), 15 mm., left eye on ridge; gobies, 7–16 mm.; dragonets, 4·8 to 7·8 mm.

VICINITY OF INCHKEITH.—Surface, 27th October 1891. Young rocklings (Couch's mackerel midge), 29·3 to 40 mm.; clupeoids (herring ?), 17 to 21 mm.

LARGO BAY.—Dredged 29th October 1891. Young grey gurnard, 29 mm., brightly coloured.

EAST OF INCHKEITH.—Bottom (10–12 fathoms), 2nd October 1891. Clupeoids (herrings ?), 22–25 mm.; rockling, 3·5 mm.

OFF ELIE.—Surface, 2nd November 1891. Rocklings, 31·5 to 38 mm.

OFF ELIE.—Net at 15 fathoms, 2nd November 1891. Clupeoids (herring ?), 21 to 29 mm.; pleuronectid (dab ?), 14 mm., eye on ridge; dragonet, 6 mm.

OFF CAR CRAIG.—Side tow-net, 2nd December 1891. Young dab, 17 mm., eyes on left side.

CLOSE INSHORE, NEAR CULROSS.—New bottom-net, 2nd December 1891. Sprats, 36·5 to 39 mm.; gobies, 17 to 20 mm.

SANDSIDE.—Bottom, 16th December 1891. Gobies, 13 to 42 mm.

SANDSIDE.—Surface, 16th December 1891. Young eel, 66 mm.

STATION IX.—Surface, 14th January 1892. 3 eggs of long-rough dab; embryonic 1 with optic capsules well formed, others earlier.

STATION II.—Bottom, 19th January 1892. Young dabs, 15 to 18 mm.; sprats, 43 to 57 mm.; gunnel, 82 mm.

STATION I.—Bottom, 18th February 1892. 2 post-larval Montagu's suckers, 4·5 mm.

STATION II.—Surface, 18th February 1892. Single egg of long-rough dab, embryo not yet outlined.

STATION II.—? Bottom, 10th March 1892. 9 eggs of dab.

STATION IV.—Bottom, 12th March 1892. Larval Montagu's sucker, 4 mm.

STATION VII.—Surface, 14th March 1892. 1 egg of plaice, embryo $\frac{5}{6}$ths round yolk, and with pigment; 4 eggs of long-rough dab, embryo half round yolk in 2, another just outlined, and on the fourth (the smallest egg), blastoderm had only begun to extend over yolk; 1 egg of haddock.

STATION VI.—Bottom, 16th March 1892. Young sand-eel, 5·5 mm.; 3 Montagu's suckers, 5 mm.

STATION VIII.—Surface, 16th March 1892. 99 eggs of plaice, apparently at an early stage, but their condition was unsatisfactory; 464 eggs of haddock; 45 eggs of cod; 71 of long-rough dab; 13 eggs of dab.

STATION IX.—Surface, 16th March 1892. A very large collection of ova; 5500 eggs of haddock and allies; 1542 eggs of plaice, early, but indistinct; 1600 eggs of long-rough dab, chiefly in early stages; 50 eggs of cod; 286 eggs of whiting, early stages; 57 eggs of dab and flounder.

8 TO 12 MILES EAST OF ISLAND OF MAY.—Surface, 5th April 1892 12 noon to 2 P.M. A very large and important collection, the largest of the series. Unfortunately the preservation was defective. Nearly three-fourths of the eggs in bulk consisted of the eggs of the haddock (roughly estimated at 10 or 11,000), and probably those approaching them in size and appearance, such as those of the bib. The embryos in those eggs of the haddock that could be distinguished were from $\frac{1}{2}$ to $\frac{3}{4}$ round the yolk. The next series were the eggs of the long-rough dab which may be roughly estimated at 5 or 600; in a few which could be made out the embryos had the tail just free from the yolk. The eggs of the plaice were about 250 in number, and in 1 the embryo was half round the yolk. There were fully 500 eggs of cod and whiting. A considerable number of the eggs of the dab, sprat, and rockling were also included in the collection, but only a very few of the gurnard.

A FEW MILES EAST OF THE ISLAND OF MAY.—New bottom-net.* Ova 'probably captured while the net was being hauled up or let down;' 5th April 1892. Imperfectly preserved. About 696 eggs of haddock and others, including cod; a few eggs of whiting; 24 eggs of rockling; 26 eggs of plaice; and 80 eggs of long-rough dab, embryos apparently in early stages, though one or two had the tail free.

CROSS SECTION I., NORTH HALF.—Tow-net about 1 fathom under the surface. A large collection. The bulk of the ova consisted of those of the haddock, the embryos being from $\frac{1}{2}$ to $\frac{3}{4}$ round the yolk to almost ready to hatch; next came the long-rough dab, embryos mostly in the earlier stages, but some were ready to hatch; then eggs of cod, plaice, sprat, whiting, dab, and rockling followed in smaller numbers.

CROSS-SECTION I., SOUTH HALF.—Tow-net, 1 fathom beneath surface, 6th April 1892. The most numerous eggs were those of the haddock, the embryos being about $\frac{3}{4}$ round the yolk, others ready to hatch; then long-rough dab, embryos at various stages, half round the yolk or with tail free; plaice, embryos $\frac{1}{2}$ round the yolk, others almost ready to hatch; and eggs of cod, bib, whiting, and rockling.

CROSS-SECTION I.—Tow-net at 8 to 10 fathoms, 6th April 1892. Eight sand-eels, 8·3 to 17 mm.; 7 herrings, 9·5 to 10 mm.; 2 sprats (?), 7 and 7·5 mm.; 2 Montagu's suckers, 5 and 6 mm.; 1 *Cottus*, 6 mm.

CROSS-SECTION II.—Surface, 8th April 1892. A small collection of ova, consisting of a few eggs of haddock, plaice (some ready to hatch), long-rough dab, dab, sprat, and rockling.

CROSS-SECTION II.—Tow-net, 6 to 10 fathoms under the surface, 8th April 1892. A considerable collection of ova. About 540 eggs of haddock; 593 eggs approaching these, and probably mostly haddock; 198 chiefly cod; plaice, 152; long-rough dab, 146; whiting, 12; besides a few eggs of bib and gurnard, and a considerable number of sprat and rockling. The contrast between this and the foregoing collection is noteworthy.

CROSS-SECTION II. (?)—Tow-net at 10 fathoms, 8th April 1892. Eight sand-eels, 7 to 13 mm.; 1 clupeoid, 8 mm.; 1 post-larval *Cottus*, 6·5 mm.; 4 post-larval Montagu's suckers, 5·5 mm.

BETWEEN FIDRA AND ELIE NESS.—Surface, 8th April 1892. Considerable living collection sent to St Andrews. The most numerous were the eggs of the haddock at various stages—from the formation of the germinal cavity, or the blastoderm half over the yolk, to embryos with black

* Termed 'M'Intosh' net on the labels.

pigment, and nearly ready to hatch. The eggs of the long-rough dab were very plentiful, and in these many nuclei appear on the surface of the yolk (protoplasmic investment) beyond the rim. They, indeed, form an embossed belt beyond it. After preservation the surface of the yolk is minutely areolar, apparently from the distinctness of the blastodermic covering. These eggs, in regard to development, varied from the formation of the germinal cavity almost up to the hatching period. A considerable number of the eggs of the cod, at similar stages of progress, of the plaice, of the dab, and of the rockling, were also present. This collection was valuable, since it showed that, even in a living series, the variety of ova was not greater, on similar ground, than those forwarded in the preserved conditions. Moreover, they formed a useful comparison with those collected on the same date in St Andrews Bay, and will be again referred to under the modes of preservation and the resulting contraction of the eggs.

Vicinity of Inchkeith.—Surface, 9th April 1892. A small collection Twenty-eight eggs of haddock; 41 of cod and allies; 41 of whiting, embryo ⅔ round yolk; of plaice, embryo almost ready to hatch; and 2 eggs, near plaice in size, 1·3716 mm. and 1·4478 mm.; 5 eggs of dab; a few eggs of sprat; 43 eggs of rockling, ¾ round yolk.

Cross-Section III.—Surface, 11th April 1892. A small collection. Thirty-six eggs of haddock, embryo at various stages up to that with largely developed pigment and nearly ready to hatch; 42 of cod and allies; 16 eggs of long-rough dab, embryo just formed in some, in others ⅔ round yolk; 2 eggs of plaice, 1 almost ready to hatch a few eggs of dab, flounder, and sprat, and a few of rockling, with embryo ½ to ⅔ round yolk.

Cross-Section III.—Tow-net, 5 to 8 fathoms, 11th April 1892. Sixty-one eggs of haddock, from early stage to hatching period; 45 eggs of cod and allies; 58 of dab; 11 of long-rough dab, embryo with short tail free from yolk in all; 7 of plaice far advanced, 2 or 3 with richly developed black pigment, and almost ready to hatch; a few eggs of whiting, sprat (embryo ½ round yolk), and rockling.

Vicinity of Inchkeith.—Side (surface?) tow-nets, 11th April 1892. Post-larval armed bullheads, 4·5 to 6·5 mm.; sand-eels, 6 to 9 mm.; rocklings, 3·5 mm.

Vicinity of Culross.—'M'Intosh' net, 12th April 1892. Eel, 72 mm.

Station V.—Surface, 16th April 1892. A considerable collection of eggs. The majority consisted of the eggs of the haddock and those near it in size, the embryo being at various stages from ½ to ⅔ round yolk; those of the long-rough dab come next in order, most intermediate between ½ round the yolk and those ready to hatch; a considerable number of plaice, embryo ½ to ⅔ round; many eggs of cod and allies, embryo from ½ to ⅔ round yolk, and with pigment; a few eggs of dab and flounder, from early stages to embryo ½ round yolk.

Station V.—Bottom, 16th April 1892. Young wolf-fish (*Anarrhichas*), 22 mm.; sand-eels, 9·5 to 16 mm.; clupeoids (herring), 7·2, with large yolk-sac, to 17 mm.; Montagu's suckers, 5·5 to 6·5 mm.; young *Cotti*, 9 to 10 mm.

Cross-Section III.—Surface, 19th April 1892. Few ova. Eggs of haddock, embryo chiefly advanced, with tail touching head, and others ready to hatch; 8 eggs of long-rough dab, embryo variable, from just outlined to almost ready to hatch; a single egg of plaice, embryo just formed; a few eggs of dab, embryo ½ to ¾ round yolk; eggs of rocklings, from early stage to embryo ¾ round yolk; post-larval rocklings, 6·5 mm.

CROSS-SECTION III., NORTH END.—Surface, 19th April 1892. Few ova. The majority consisted of the eggs of the haddock, embryo from $\frac{3}{4}$ round yolk to richly-pigmented condition; eggs of cod and allies followed, embryo from $\frac{3}{4}$ to hatching stage; a few of long-rough dab, from the closure of the blastopore to nearly ready to hatch, mostly advanced; a few eggs of plaice, all advanced, some almost ready to hatch; a few eggs of dab, sprat, and rockling, and 1 of gurnard.

CROSS-SECTION III., MIDDLE PART.—Surface 19th April 1892. A considerable collection. Most were eggs of haddock, embryo advanced, from $\frac{3}{4}$ round yolk to tail touching head; eggs of long-rough dab, embryo from just formed to ready to hatch, most in an intermediate stage; a few eggs of cod, embryo $\frac{1}{2}$ round; 3 eggs of plaice, embryo $\frac{5}{6}$ round; and a few eggs of sprat, embryo $\frac{1}{2}$ round yolk.

CROSS-SECTION III.—Mid-water-net, 6 fathoms, 19th April 1892. Comparatively few eggs. The eggs of the haddock were most numerous, embryo $\frac{2}{3}$ round yolk, and others ready to hatch; a few of cod and bib, embryo $\frac{1}{2}$ to $\frac{2}{3}$ round yolk; next to haddock in number were the eggs of the long-rough dab, from closure of blastopore to advanced embryo, but not ready to hatch. Sand-eels, 8 to 12 mm.; young *Cotti*, 6·5 to 7·2 mm.; young armed bullhead, 8·3 mm.

CROSS-SECTION III.—Bottom, 19th April 1892. Two sand-eels, 8·5 and 9 mm.; 3 herrings, 10·5 to 11·5 mm; Montagu's suckers, 4 to 7·2 mm.

STATION II.—Surface, 21st April 1892. Few ova. 70 eggs of haddock, embryo from $\frac{3}{4}$ round yolk to ready to hatch; 13 eggs of long-rough dab, all advanced, approaching hatching; a few eggs of cod, poor-cod, whiting, sprat, and rockling 4, dab 6, embryo (from $\frac{1}{2}$ to $\frac{3}{4}$ round); 5 eggs of plaice, embryo from $\frac{1}{2}$ round yolk to nearly ready to hatch.

STATION II.—Bottom (shrimp-trawl), 21st April 1892. Post-larval cod, 3·8 mm; clupeoids, 7 mm. (with yolk-sac) to 12 mm.; sand eels, 7 to 8·5 mm.; Montagu's sucker, 4·5 mm.; young *Cottus*, 6·3 mm.; young dab (?), 4·5 mm.

STATION III.—Surface, 25th April 1892. 15 eggs of the haddock; 3 of long-rough dab, embryo $\frac{1}{2}$ round yolk; 2 eggs of plaice, embryo advanced and pigmented; a few of whiting, cod (embryo $\frac{2}{3}$ to $\frac{4}{5}$ round yolk); rockling and dab, embryo about $\frac{1}{2}$ round.

STATION III.—Bottom, 25th April 1892. 4 sand-eels, 8 to 9·5 mm.; 4 clupeoids, 7 to 10 mm.; 2 gadoids (cod ?), 3 mm.; post-larval, Montague's sucker, 6 mm.

STATION IV.—Surface, 25th April 1892. 42 eggs of haddock and allies, all advanced, and some almost ready to hatch; 32 of bib, and pleuronectids (?), all advanced, and nearly ready to hatch; 26 of cod, sprats (embryo $\frac{1}{2}$ to $\frac{3}{4}$ round yolk), and whiting; 1 egg of plaice, embryo nearly ready to hatch; 6 eggs of long-rough dab, embryo nearly ready for escape; 10 eggs of dab, embryo $\frac{1}{2}$ round yolk to nearly complete circuit; 41 eggs of rockling, from embryo just formed to stage with rich pigment and ready to hatch.

STATION IV.—Bottom, 25th April 1892. 3 post-larval gadoids (cod ?), 3 to 4 mm.; gadoid (injured), with much black pigment on head and dorsum, 8 mm.; 8 clupeoids, 5 to 9 mm.; 3 sand-eels, 5 to 9·5 mm.; 7 rocklings, 3 to 6 mm.; 2 armed bullheads, 5 and 5·5 mm.; pleuronectid (injured), 6 mm.; post-larval Montagu's sucker, 6·5 mm.

STATION I.—Surface, 26th April 1892. 76 eggs of haddock; 87 of cod and allies, some with embryo $\frac{3}{4}$ round yolk; 11 eggs of bib, &c.; 1 egg of gurnard; 3 eggs near whiting; 49 injured eggs, apparently of

the sprat; 22 of flounder and dab, embryo about $\frac{2}{3}$ round yolk; 26 eggs of rockling, embryo from $\frac{2}{3}$ to $\frac{3}{4}$ round yolk.

STATION VI.—Surface, 26th April 1892. 39 eggs of haddock, embryo advanced, nearly ready to hatch; 21 eggs of cod and allies, embryo from $\frac{1}{2}$ to $\frac{3}{4}$ round in those in which the condition was visible; 9 eggs of whiting, embryo $\frac{3}{4}$ round yolk; 1 egg of gurnard, embryo $\frac{1}{2}$ round yolk; 24 eggs of rockling, embryo from early stage to almost ready to hatch; 6 eggs of dab; 2 eggs of plaice, both advanced, 1 ready to hatch, with rich pigment; young long-rough dab (?), 10·5 mm., left eye appearing on ridge.

STATION VI.—Bottom, 26th April 1892. 4 post-larval gadoids (cod?), 3 to 4·5 mm.; 4 clupeoids, 6 to 12·5 mm.; 2 rocklings, 4·5 mm.; 2 sand-eels, 12 mm.

STATION III.—Surface, 28th April 1892. A small collection of ova. A few eggs of haddock, all advanced, and some ready to hatch; eggs of cod and whiting, embryo $\frac{1}{2}$ to $\frac{2}{3}$ round yolk; eggs of rockling, embryo $\frac{3}{4}$ round yolk; eggs of dab, embryo from $\frac{1}{2}$ to $\frac{4}{5}$ round yolk; 3 eggs of plaice, highly pigmented, and nearly ready to hatch; 4 eggs of long-rough dab, from stage with tail just free from yolk to stage nearly ready to hatch; 5 sand-eels, 8 to 13 mm.

STATION III.—Bottom, 28th April 1892. 9 sand-eels, 8·5 to 9·4 mm.; 1 post-larval pleuronectid (long-rough dab?), 4·2 mm.; 1 rockling, 3·5 mm.; 3 post-larval Montagu's suckers, 3·8 to 6 mm.

NINE MILES EAST OF THE ISLAND OF MAY.—Mid-water net, 7th May 1892, 1 hour. 9 pleuronectids, apparently plaice, 7 to 17 mm.; 3 gadoids, 5·3 to 9 mm.; sand-eel, 14 mm.; 4 rocklings, 3·5 to 5·5 mm., the latter with long blackish ventrals.

SIX TO EIGHT MILES SOUTH-SOUTH-EAST OF BELL ROCK.—Mid-water-net, 7th May 1892. 10 pleuronectids, long-rough dab (?), 6·5 to 21 mm.; the left eye just appearing on the ridge in the largest examples; 1 gadoid (like haddock), 12 mm.; 1 sand-eel, 14·5 mm.

VICINITY OF BELL ROCK.—Mid-water-net, 7th May 1892. 3 gadoids, 12 to 22 mm.; sucker, 7·5 mm; 1 rockling, 5·5 mm.; 7 pleuronectids (long-rough dab and plaice?), 8 to 20 mm., left eye appearing on the ridge in the larger examples.

NORTH-WEST OF LISTON BANK.—Surface, 7th May 1892. 1 gadoid, 17 mm.; 1 sand-eel, 24 mm., with young *Caligus* attached ventrally to pectoral region; 1 young gurnard, 28 mm.

LISTON BANK.—Mid-water-net, 1 hour, 7th May 1892. 6 gadoids, 4·5 to 13 mm.; 8 pleuronectids (long-rough dabs and plaice), 3·5 to 11 mm.; sand-eel, 21 mm.

STATION I.—Surface, 11th May 1892. 12 eggs of the haddock, embryo almost ready to hatch; 93 eggs of cod (?) and allies, embryo about $\frac{2}{3}$ round yolk; 3 eggs of gurnard, embryo $\frac{1}{2}$ round yolk; 35 eggs of sprat, embryo $\frac{1}{2}$ to $\frac{2}{3}$ round yolk; 24 rocklings (smaller form), embryo $\frac{2}{3}$ round yolk; 1 larger species, embryo $\frac{2}{3}$ round yolk; 4 eggs of dab, embryo $\frac{2}{3}$ round yolk; 1 egg of long-rough dab, embryo advanced.

STATION III.—Surface, 14th May 1892. 44 eggs of cod and allies (?), embryo from $\frac{2}{3}$ to $\frac{4}{5}$ round yolk; 4 eggs of gurnard, embryo $\frac{2}{3}$ round yolk; 25 eggs of rockling, embryo $\frac{4}{5}$ round yolk.

STATION III.—Bottom, 14th May 1892. 1 gadoid, 14·5 mm.; 4 clupeoids (herrings), 11 to 19 mm.; 1 Montagu's sucker, 5 mm.; 1 pleuronectid (long-rough dab), 7·5 mm.

STATION V.—Surface, 17th May 1892. 5 eggs, like plaice, embryo-encircling yolk; 14 eggs, 1·066 to 1·219 mm. near cod and haddock (gadoid or pleuronectid); 9 eggs of rockling (two species).

STATION V.—Bottom, 17th May 1892. *Cottus*, 5·5 to 8 mm.; Montagu's sucker, 6·5 to 8 mm.; 3 pleuronectids, 5·5 to 20 mm.

STATION I.—Surface, 17th May 1892. 1 egg of gurnard; 209 eggs of sprat, &c., some embryos just formed, to $\frac{3}{4}$ round yolk; 80 eggs of rockling, embryo at various stages to $\frac{3}{4}$ round yolk.

STATION I.—Bottom, 17th May 1892. 1 clupeoid, 8 mm.; Montagu's sucker, 7·5 mm.; 3 rocklings, 3·5 to 5 mm.; 1 armed bullhead, 8·5 mm.

STATION VII.—Surface, 17th May 1892. 4 eggs of gurnard, embryo from $\frac{1}{2}$ to $\frac{4}{5}$ round yolk; eggs, 15 sp. Ross-near haddock- and others; 11 eggs of poor-cod, &c., embryo $\frac{1}{2}$ to $\frac{3}{4}$ round yolk; 9 eggs of rockling, embryo from $\frac{1}{2}$ to $\frac{4}{5}$ round yolk.

STATION VII.—Bottom, 17th May 1892. 4 clupeoids, 20 mm.; 1 sand-eel, 9 mm.; 6 Montagu's suckers, 3·5 to 6·5 mm.; 3 pleuronectids (long-rough dab ?), 9·5 to 10·5 mm.; 4 gadoids, 3·5 to 6 mm.; 3 rocklings, 2·5 to 5 mm.; 2 armed bullheads, 8 and 9 mm.

STATION VI.—Bottom, 20th May 1892. Montagu's sucker, 7·5 mm.; pleuronectid, 12·5 mm.

STATION 0.—Surface, 24th May 1892. 3 sand-eels, 11·5 to 15·5 mm.

STATION 0.—Bottom, 24th May 1892. 1 clupeoid, 12 mm. (injured); 1 pleuronectid (long-rough dab), 8 mm.

STATION VIII.—Surface, 25th May 1892, 23 eggs of gurnard, embryo $\frac{1}{2}$ to $\frac{4}{5}$ round yolk; 6 eggs near cod and lemon-dab, and near haddock, &c., embryo $\frac{1}{2}$ to $\frac{2}{3}$ round; 16 eggs about size of poor-cod, embryo $\frac{1}{2}$ round to nearly ready to hatch; 6 eggs of rockling, embryos just formed, and advanced.

STATION VIII.—Bottom, 25th May 1892. Post-larval long-rough dab (?), 6 mm.; pleuronectids, 17·5 mm.

STATION IX.—Surface 25th May 1892. 77 eggs of gurnard, embryo just formed, others nearly ready to hatch; 20 eggs of poor-cod and sprat, embryos all advanced; 22 eggs of lemon-dab and other forms near haddock, embryos chiefly half round yolk; 17 eggs of rockling, from $\frac{1}{2}$ to $\frac{2}{3}$ round yolk.

LISTON BANK.—Surface, 26th May 1892. 29 eggs of gurnard, embryo about $\frac{2}{3}$ round the yolk; 15 eggs, near size of haddock, embryo about $\frac{2}{3}$ round yolk; 94 eggs of whiting, &c., embryo at various stages; 33 eggs, chiefly rockling, with a few of dabs, imperfectly preserved.

LISTON BANK.—Mid-water, 26th May 1892. 12 gadoids, 4 to 11 mm.; 7 pleuronectids, 9 to 13 mm.

LISTON BANK.—Bottom, 25th May 1892. 2 pleuronectids, 4 and 5 mm., near topknot (?).

WEST OF LISTON BANK.—Surface, 26th May 1892. 129 eggs of gurnard, embryo visible only in a few, and about $\frac{2}{3}$ round yolk; 35 eggs near haddock, though somewhat less, embryo $\frac{1}{2}$ to $\frac{2}{3}$ round; 90 eggs of whiting, &c., embryo $\frac{1}{2}$ to $\frac{2}{3}$ round; 38 eggs of rockling, with a few of dab; embryo $\frac{1}{2}$ to $\frac{2}{3}$ round; 1 plaice-like egg, and others near bib.

WEST OF LISTON BANK.—Mid-water-net, 1st haul, 26th May 1892. 4 gadoids, 6·5 to 9·2 mm.; 2 pleuronectids, 7 and 11 mm.

BETWEEN LISTON BANK AND MAY ISLAND.—Mid-water-net, 2d haul, 26th May 1892. 13 sand-eels, 14 to 19·5 mm.; 7 gadoids, 7·5 to 14·5 mm.; 4 pleuronectids (lemon-dab), 8 to 12·5 mm.

BETWEEN LISTON BANK AND ISLAND OF MAY.— Surface, 2nd haul, 26th May 1892 (?). 117 eggs of gurnard, embryo, when visible, $\frac{1}{2}$ to $\frac{3}{4}$ round yolk; 1 egg near topknot; 21 eggs of whiting and dab; 8 eggs of rockling.

BETWEEN LISTON BANK AND MAY ISLAND.—Bottom-net, 2nd haul, 26th

May 1892. 2 clupeoids, 18 and 19 mm.; 5 gadoids, 7 to 17 mm.; 1 gunnel, 25 mm.; 4 pleuronectids, 8 to 14·5 mm.

WEST OF LISTON BANK.—Bottom-net, 1st haul, 26th May 1892. 2 gadoids, 7 to 11 mm.; 1 armed bullhead, 13·5 mm.

CROSS-SECTION II., SOUTH HALF.—Surface, 27th May 1892. 8 eggs of gurnard; 697 eggs, chiefly of sprat, with a few of whiting, &c.; 52 eggs of rockling, two species.

CROSS-SECTION II., SOUTH HALF.—Surface-net, 27th May 1892. Lemon-dab, 12·5 mm., left eye appearing on ridge.

CROSS-SECTION II., SOUTH HALF.—Eight fathoms tow-net, 27th May 1892. Five sand-eels, 8 to 16·5 mm.; 13 clupeoids, 12 to 21 mm.; pleuronectids—4·5 to 13 mm.; 2 post-larval gadoids, 4 and 5 mm.; 1 rockling, 3 mm.

CROSS-SECTION II., SOUTH HALF.—Bottom-net, 27th May 1892. Ten sand-eels, 9·5 to 19 mm.; 14 clupeoids, 16 to 21·5 mm.; 1 gadoid, 13 mm.; 4 pleuronectids, 4·5 to 10 mm.

CROSS-SECTION II., NORTH HALF.—Surface, 27th May 1892. Eighty eggs of gurnard; 177 eggs of sprat, &c.; 3 eggs near lemon-dab; 31 eggs of rockling.

CROSS-SECTION II., NORTH HALF.—Eight fathoms tow-net, 27th May 1892. Thirteen sand-eels, 9·2 to 21·5 mm.; 11 clupeoids, 8·5 to 18 mm.; 25 pleuronectids, 4·5 to 12 mm.; 14 gladoids, 4·5 to 8·5 mm.

CROSS-SECTION II., NORTH HALF.—Bottom-net, 27th May 1892. Three gadoids, 5·5 to 7·5 mm.; 2 sand-eels, 10 mm.; 9 clupeoids, 8·5 to 17 mm.; 10 pleuronectids (chiefly lemon-dabs), 5 to 12.5 mm.

CROSS-SECTION I., MID-WAY.—Surface, 30th May 1892. Fifty eggs (chiefly gurnard, with some of brill), embryo $\frac{4}{5}$ round yolk; 7 eggs about 1·1430 mm., embryo advanced; 11 eggs near poor-cod, embryo advanced—with pigment; 14 eggs of rockling, two species, embryo $\frac{4}{5}$ round yolk.

CROSS-SECTION I., MID-WAY.—Mid-water-net, 30th May 1892. Eight sand-eels, 8 to 24 mm.; 3 clupeoids, 7, 12, and 18 mm.; 2 gadoids, 5 and 9·5 mm.; 1 *Cottus*, 5 mm.; 2 pleuronectids, 5·5 mm.

CROSS-SECTION I., MID-WAY.—Bottom, 30th May, 1892. Four sand-eels, 8·5 to 25 mm.; 5 clupeoids (sprats), 7·5 to 17 mm.; 3 gadoids, 5 to 7 mm.; 6 pleuronectids, 4 to 12 mm.

CROSS-SECTION I., NORTH END.—Surface, 30th May 1892. Twenty-eight eggs of gurnard, embryo $\frac{4}{5}$ round yolk; 14 eggs near cod and bib, embryo with black pigment; 11 eggs sprat and whiting, embryo $\frac{2}{3}$ round yolk, to nearly ready to hatch; 14 eggs of rockling, two species.

CROSS-SECTION I., NORTH HALF.—Mid-water-net, 30th May 1892. One sand-eel, 18·5 mm.; 4 clupeoids, 18 mm.; 5 gadoids, 5·5 to 9·5 mm.; 8 pleuronectids, 4·5 to 15 mm.

CROSS-SECTION I., NORTH HALF.—Bottom-net, 30th May 1892. Two gadoids, 6 and 7 mm.; 5 pleuronectids, 5 to 14·5 mm., left eye appearing above ridge.

CROSS-SECTION III., SOUTH HALF.—Surface, 31st May 1892. Nineteen eggs of gurnard, embryo $\frac{1}{2}$ round where visible; 22 eggs, those of about 1·0287 mm. near cod in size; 48 eggs of sprat, with a few like whiting, embryo chiefly advanced; 29 eggs, chiefly of rockling (preservation imperfect).

CROSS-SECTION III., NORTH HALF.—Surface, 31st May 1892. Two hundred and two eggs of gurnard; 75 eggs of sprat, probably with a few eggs of injured whiting; 238 eggs of rockling (two species).

CROSS-SECTION III., NORTH HALF.—Surface, 31st May 1892. Two

eggs of gurnard; 1 of sprat; 1 clupeoid, 20 mm.; 1 gadoid (green cod), 15 mm.; 21 pleuronectids, 11·5 to 15 mm.

CROSS-SECTION III., NORTH HALF.—Mid-water-net, 31st May 1892. Three sand-eels, 9·5 to 13 mm.; 10 clupeoids, 7 to 22 mm.; 5 gadoids, 4·5 to 11·5 mm.; 3 rocklings, 4·8 mm., with black ventrals; 8 pleuronectids, 5·5 to 13 mm.; lumpsucker, 6 mm.

CROSS-SECTION III., NORTH HALF.—Bottom, 31st May 1892. One clupeoid, 19 mm.; 1 gadoid, 12 mm.; 1 Montagu's sucker, 6 mm.; 3 pleuronectids, 11 to 16 mm.

CROSS-SECTION III., SOUTH HALF.—Surface tow-net, 31st May 1892. Eight pleuronectids, 11 to 14·5 mm.

CROSS-SECTION III., SOUTH HALF.—Mid-water-net, 31st May 1892. One sand-eel, 14 mm.; 9 clupeoids, 7·5 to 23·5 mm.; 2 gadoids, 4 and 7·5 mm.; 5 pleuronectids, 11 to 15 mm.

CROSS-SECTION III., SOUTH HALF.—Bottom tow-net, 31st May 1892. One sand-eel, 12 mm.; 3 clupeoids, 19 mm.; 1 gadoid, 6 mm.; 7 pleuronectids, 5 to 12 mm.

BETWEEN HERRIOT AND ROST STATIONS.—Surface, 1st June 1892. One egg of gurnard, embryo ½ round yolk; 3 eggs of sprat, embryo ½ to nearly encircling yolk; 2 eggs of rockling; 2 clupeoids, 14·5 mm.; 2 pleuronectids, 9·5 to 11·5 mm. (dabs).

BETWEEN HERRIOT AND ROST STATIONS.—Mid-water and bottom-nets, 1st June 1892. One clupeoid, 17·5 mm; 3 gadoids, 5·5 to 8 mm.; 1 pleuronectid, 12 mm.

LISTON BANK.—Surface, 1 hour, 7th May 1892. One hundred and fifty eggs of gurnard; 7 eggs of dab.

VICINITY OF BELL ROCK.—Surface, 7th May 1892. Eleven eggs of gurnard; 6 eggs near haddock; 8 eggs near cod; 1 egg of dab.

NINE MILES EAST OF ISLAND OF MAY.—One hour. Surface, 7th May 1892. Eight eggs of gurnard; 2 eggs of sprat; and 2 injured (unknown).

WEST OF EYEBROUGH.—Over 1 hour, mid-water, 2nd June 1892. Five gobies, 2·2 to 5 mm.

## IV. ST ANDREWS BAY.

STATION V.—Surface, 2nd July 1891. A considerable number of eggs of gurnard at various stages, most of the embryos being about ¾ round yolk; numerous eggs of sprat at advanced stages; a few like poor-cod (?); a few of dab, with embryos from ½ to ¾ round yolk; many eggs of rockling, with embryos in same condition.

STATION I.—3rd July 1891. A considerable collection of eggs, but whether from surface or bottom is not stated. The majority consist of the eggs of the gurnard (about 600), mostly with advanced embryos, many of sprat, a series about the size of those of the lemon-dab, one or two like whiting, a few of turbot and topknot, one of weever (?), and a few of dab (?). Besides the foregoing, and a considerable number of the eggs of rocklings, is the single large egg of the frog-fish (1·6764 mm.), described in a previous part of the Report. Plaice-like young pleuronectids, 11 mm. in length, with the left eye rising to the ridge; young lumpsuckers, 9 to 10 mm.

STATION II.—3rd July 1891. A considerable number of eggs.† Many of gurnard, with advanced embryos; many of sprat, with embryos ⅝ to ¾

† Preserved in picro-sulphuric solution, with 30 per cent. spirit added. To 1 part of this 5 parts of water were added, and the eggs placed in spirit.

round yolk; a few near bib (?); a few like those of dab; many eggs of rockling, chiefly advanced.

Station I.—Surface, 22nd July 1891. A small number of eggs. 19 of gurnard; 170 of sprat, with embryos $\frac{2}{3}$ to nearly encircling yolk; 73 of rockling, with embryo $\frac{1}{2}$ round yolk; a few of dragonet.

Station III.—Bottom, 22nd July 1891. Post-larval pleuronectid, 5·2 mm.; gobies, 4 to 5·5 mm.; young great pipe-fishes, 16 to 22 mm.

Station V.—Bottom, 22nd July 1891.—Pleuronectid, 7 mm. (dab?), eyes symmetrical; young rockling, 3·8 mm.; young gobies, 3 to 5 mm.

Station V.—Bottom, 1st October 1891.—Pleuronectid, 11 mm., left eye just visible on ridge; young gobies, 10 to 15 mm.; young bimaculated sucker, 7·5 mm.; young dragonet, 5 mm.

Station I.—Bottom, 2nd October 1891.—Young whiting, 45 mm., with elongated filaments to the pelvic fins.

Station V.—Bottom, 3rd November 1891. A single young bimaculated sucker, 8 mm.

Station V.—Bottom (?), 7th March 1892. 4 eggs of haddock, 1 with embryo about $\frac{3}{4}$ round yolk and with pigment, others $\frac{1}{2}$ round yolk; 2 eggs of plaice, injured; post-larval Montagu's sucker, 5·2 mm.

Station I.—Bottom, 8th March 1892. 1 pelagic egg (probably of dab), injured; 3 larval sand-eels, 5 mm., the oil-globule still present in the yolk-sac of two; 5 post-larval Montagu's suckers, 4·5 mm.

Stations I. and II.—Surface, 8th March 1892. Small collection. 43 eggs of haddock, with embryo more than $\frac{1}{2}$ round the yolk; 13 of long-rough dab, with embryo about $\frac{1}{2}$ round the yolk; 3 of cod, with embryo more than $\frac{1}{2}$ round yolk; 11 of plaice, with embryo about $\frac{1}{2}$ round; 5 of rockling (probably *Motella tricirrata*), with embryo outlined.

Station VI.—Surface, 14th April 1892. A comparatively large collection. Many eggs of haddock; small number of eggs of cod; considerable number of the eggs of the long-rough dab, with the embryo $\frac{2}{3}$ round the yolk, and some with pigment—almost ready to hatch; eggs of plaice (about 20), with the embryo at various stages, from $\frac{1}{2}$ round yolk to almost ready to hatch; eggs of rockling, with embryo about $\frac{1}{2}$ round yolk.

Station VI.—Bottom, 14th April 1892. Eggs of plaice, haddock, cod, dab, sprat, rockling (*M. tricirrata*), and others, all in a dense mass of Sagittæ, larval annelids, and crustaceans. Young sand-eels, 5 to 8·5 mm.; young armed bullheads (*Agoni*), 5·6 to 7·5 mm.; young rockling, 4·5 mm.

Station I.—Surface, 15th April 1892. A considerable collection. Many eggs of haddock at various stages, viz., from $\frac{1}{2}$ round the yolk to a free portion of tail, but not ready to hatch; a few eggs of cod, embryo from $\frac{1}{2}$ to $\frac{3}{4}$ round the yolk and with pigment; a considerable number of dab and flounder, embryo from $\frac{1}{2}$ to $\frac{3}{4}$ round the yolk; a few eggs of sprat; about 30 eggs of rockling; about 30 eggs of long-rough dab, embryo from $\frac{1}{2}$ round yolk to a considerable portion of the tail free, but not ready to hatch; 5 eggs of plaice, embryo about $\frac{1}{2}$ round to $\frac{3}{4}$ round yolk.

Station I.—Bottom, 15th April 1892. Moderate collection. A considerable number of eggs of haddock, about the same stages as the foregoing; a few of cod; 2 eggs of long-rough dab; a considerable number of eggs of dab and flounder, with embryos $\frac{1}{2}$ to $\frac{4}{5}$ round the yolk; a few eggs of rockling, with embryo $\frac{3}{4}$ round yolk. Young clupeoids 6·5 to 7·5 mm. —some of them newly hatched; young sand-eels 6 to 10 mm.; young rocklings, 3 to 6 mm.; post-larval plaice (?), 7·5 mm.

Larval long-rough dab (?), (Pl. XV. fig. 2).

This last specimen is about 3 mm. in length, with the yolk-sac

still of considerable size, and apparently without an oil-globule, but the sac was injured. The somewhat elongate body is surrounded by a deep marginal fin (it is shrivelled in the sketch) which is minutely speckled with vesicles, as in the brill and turbot, though in this example they appeared finer than in either—a condition, however, that might have been due to the mode of preparation. The great elongation of the body in proportion to the size of the yolk-sac is diagnostic in contrast with most larvæ, and the depth of the marginal fin in the caudal region is also noteworthy. A distinct pre-anal portion of the marginal fin occurs between the yolk-sac and the anus, which is at the ventral edge. An opaque region about midway between the lens and the posterior border of the yolk probably indicates the otocyst. A few black chromatophores occur on the head, and are continued along the side to the ventral border of the notochord. They form a somewhat interrupted series along the ventral muscle-plates to the tail, a few likewise occurring dorsally in the latter region.

STATION II.—Surface, 15th April 1892. Small collection. A few eggs of haddock, embryo from ½ round to stage with tail touching head; a very few eggs of cod; a few eggs of dab and flounder, embryos ½ to fully ¾ round yolk; six eggs of long rough dab, embryos nearly ready to hatch; 1 egg of plaice, embryo ½ round yolk.

STATION II.—Bottom, 15th April 1892. A larger collection than foregoing. Considerable number of eggs of haddock, embryos ½ round yolk to tail touching head, and pigmented; a few eggs of cod; considerable number of eggs of dab and flounder, embryos from ½ to ¾ round yolk; 1 egg of plaice, embryo ½ round yolk. Post-larval plaice 8 mm., eyes symmetrical, with narrow, elongate body; one or two young clupeoids, 7 mm.; larval sand-eels, 5 mm.; young rockling, 4 mm.; post-larval armed bullheads, 5·5 to 6·2 mm.; Montagu's suckers, 3·5 to 6 mm.

STATION III.—Surface, 15th April 1892.—Moderate collection. Considerable number of eggs of haddock, embryo from ½ to ¾ round yolk; a few eggs of cod in same stages of development; upwards of 20 eggs of long-rough dab, with tail not yet free from yolk, and others almost ready to hatch; considerable number of dab, with a few of flounder, at stages varying from embryo ½ round to complete environment of yolk; about the same number of rocklings' eggs (two sizes), from the stage with embryo just outlined to ⅘ round yolk.

STATION III.—Bottom, 15th April 1892. Moderate collection—fewer than foregoing. Considerable number of eggs of haddock, embryos pigmented in most, and from ⅔ to ⅘ round yolk; a few eggs of cod at similar stages; a few eggs of rockling, embryos ⅘ to ⅚ round yolk, and in some tail almost touching head; 2 eggs of long-rough dab, in one only the tail of embryo is just free from yolk, considerable number of eggs of dab, with a few of flounder, embryos from ½ to ⅘ round yolk and coloured. Young sand-eels 5 to 10·5 mm.; young rocklings, 4 mm.; young *Cotti*, 5·2 mm. These young *Cotti*, when fresh, have prominent pigment-touches (chromatophores) on the head and dorsum after the earlier stages. A pale green tint occurs on head and upper region of the abdomen, while a prominent bar of black passes obliquely across abdomen from above downward and backward. The food usually renders the abdomen pinkish behind the black bar.

STATION IV.—Surface, 15th April 1892. Considerable collection. 180 eggs of haddock, with a few of cod intermingled (about 50), embryos from ½ to ⅔ round yolk and coloured; 45 rocklings, embryo ⅔ round yolk; 1 egg of plaice, embryo ⅔ round yolk; 3 of long-rough dab, from

early stage to ready to hatch; 30 of dab (with a few of flounder), from early stage to ⅗ round yolk.

Station IV.—Bottom, 15th April 1892. Larval sand-eels, with yolk-sac, 4·5 mm., and others to 12 mm.; young armed bullheads, 6·2 mm.; young Montagu's sucker, 3·5 mm.; young *Cotti*, 6 mm.

Station V.—Surface, 15th April 1892. Considerable number of eggs of haddock, embryo at stages from ½ round to stage with coloured eyes and body—almost ready to hatch; a few eggs of cod at similar stages; very few eggs of rockling, embryo ½ to ⅗ round yolk; 31 eggs of long-rough dab, from embryo with tail not free from yolk, to others ready to hatch; 2 eggs of plaice far advanced (tail touching head); a small number of eggs of dab, embryo ½ to ⅗ round yolk.

Station V.—Bottom, 15th April 1892. Many young sand-eels, from larval stage with oil-globule in yolk, 4·5 mm., to older forms, 10 mm.; a few clupeoids, 7 mm.; young armed bullheads, 5·8 to 8 mm.

Station IV.—Surface, 20th April 1892. Small collection. About 25 eggs of haddock, embryo from ½ to ⅗ round yolk; about same number of eggs of cod, embryo ½ to ⅗ round yolk; about 25 eggs of long-rough dab, showing embryos just formed, only one with long tail; eggs of dab (about 30), embryo ⅗ round yolk; a few eggs of sprat, and a large number of rocklings (two species), chiefly early embryos—others ½ round yolk.

Station IV.—Bottom, 20th April 1892. Clupeoids 7·5 mm., no yolk-sac, others 8·5 mm. with yolk-sac, and 9·2 mm. with trace of yolk-sac.

Station IV.—Surface, 12th May 1892. Eleven eggs of gurnard, embryo about half round the yolk; 6 eggs near haddock (1·219 mm.), embryo advanced, with pigment, and nearly ready to hatch; 3 eggs near poor-cod; 1 egg of turbot (?), embryo half round the yolk; 16 eggs of sprat, embryo from ½ to $2\frac{4}{5}$, round yolk; 20 eggs of dab, embryo ½ to ¾ round yolk; 19 eggs of rockling, (2 species) embryo from ½ to ⅗ round yolk; 2 large eggs of rockling.

Station V.—Surface, 12th May 1892. Three eggs of gurnard, embryo ½ to ¾ round yolk; 30 eggs near haddock, embryo nearly ready to hatch; 8 eggs of lemon-dab, embryo nearly ready to hatch; 43 eggs near cod and bib, embryo from ½ round yolk to nearly ready to hatch; 8 eggs of dab, embryo ½ to ⅗ round yolk; 26 eggs of rockling—2 species as before—embryo from ½ round yolk to nearly ready to hatch.

Station I.—Surface, 13th May 1892. Eight eggs of gurnard; 4 eggs near haddock, embryo nearly ready to hatch; 19 eggs chiefly of sprat, embryo advanced; 2 eggs near topknot, embryo half round yolk; 9 eggs of dab, embryo ½ to ⅗, round yolk; 5 eggs of rockling (larger size, ·6858 mm.), and 8 eggs of rockling, ·6096 mm. to ·6477 mm., embryos from ½ round yolk to later richly-pigmented stage.

Stations II. and III.—Surface, 13th May 1892. Two eggs of gurnard; 1 egg near topknot; 3 eggs, ·9906 mm., embryo ⅗ round yolk; 14 eggs like small dab, embryo ½ round yolk—same form was abundant in June, ·762 mm. when living; 5 eggs of dab, embryo about ⅗ round yolk where visible. Fourteen eggs of rockling—2 species as before—embryo from ½ round yolk to nearly ready to hatch.

| | Station I. | | | | | | | | Station II. | | | | | | Station IV. | | Station VIII. | | | | | Station IX. | | | | | | Total. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Surface Net. June 8, 1891. | Surface Tow-net. June 11, 1891. | Surface Tow-net. June 11, 1891. | Surface Tow-net. June 22, 1891. | Surface Tow-net. Aug. 14, 1891. | Surface Tow-net. April 26, 1892. | Surface Tow-net. May 11, 1892. | Surface Tow-net. May 17, 1892. | Surface Net. June 12, 1891. | Feb. 18, 1892. | March 10, 1892. | Undersurface Tow-Net. Cross section 6 to 10 fath. April 8, 1892. | Surface Tow-net. Cross section. April 8, 1892. | Surface Tow-net. April 21, 1892. | Surface Tow-net. July 17, 1891. | Surface Tow-net. April 25, 1892. | Surface Tow-net. July 21, 1891. | Surface Tow-net. March 1892. | Surface Tow-net. May 9, 1892. | Bottom Tow-net. May 9, 1892. | Surface Tow-net. May 25, 1892. | Surface Tow-net. July 21, 1891. | Surface Tow-net. Aug. 19, 1891. | Surface Tow net. March 16, 1892. | Surface Tow-net. May 6, 1892. | Bottom Tow-net. May 6, 1892. | Surface Tow-net. May 25, 1892. | |
| Haddock, | . | . | . | . | . | . | 12 | . | . | . | . | 540 | 14 | 69 | . | 42 | . | 464 | 162 | 80 | . | . | . | 5500 | 182 | 23 | . | 7038 |
| Cod, | . | . | . | . | . | 87 | 98 | . | . | . | . | . | . | . | . | 13 | . | 45 | 26 | 34 | . | . | . | 19 | 14 | 9 | . | 340 |
| Whiting, | . | . | . | . | . | . | . | . | . | . | . | 12 | . | 10 | . | 1 | . | . | . | . | . | . | . | 317 | . | . | . | 340 |
| Do. near, | . | . | . | . | . | 3 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 3 |
| Long-Rough Dab, | . | . | . | . | . | . | 1 | . | . | . | . | 146 | 6 | 12 | . | 6 | . | 71 | 15 | . | . | . | . | 1600 | 1 | . | . | 1858 |
| Topknot, | . | . | . | . | . | . | . | . | 1 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1 |
| Plaice, | . | . | . | . | . | . | . | . | . | . | . | 152 | 17 | 5 | . | 1 | . | 99 | . | . | . | . | . | 1545 | 3 | 1 | . | 1823 |
| Dab, | . | . | . | . | . | 22 | 4 | . | . | . | . | . | . | 5 | . | 10 | . | 13 | . | . | . | . | . | . | . | . | . | 54 |
| Dab and Flounder, | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 57 | . | . | . | 57 |
| Sprat, | . | . | . | 2875 | 59 | . | 35 | 209 | . | . | . | . | . | . | . | . | . | . | . | . | . | 209 | 5 | . | . | . | . | 3402 |
| Sprat and Dab, | 1208 | 3005 | 1184 | . | . | . | . | . | 3778 | . | . | . | . | . | . | 10 | . | . | . | . | . | . | . | . | . | . | 20 | 9195 |
| Ovoid, ·9144 × ·9906 mm., | . | . | . | . | . | 49 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 49 |
| Gurnard, | 29 | 24 | 65 | 148 | . | 1 | 3 | 1 | 22 | . | . | 1 | . | . | . | . | 340 | . | 39 | 13 | 28 | . | 7 | . | 10 | 7 | 77 | 810 |
| Rockling, | 46 | 649 | 403 | 81 | 102 | 20 | 25 | 80 | 176 | . | . | . | . | 4 | 48 | 42 | 714 | . | 48 | 28 | 6 | 310 | 21 | . | 17 | 6 | 17 | 2843 |
| Dragonet, | 1 | 6 | . | . | . | . | . | . | 8 | . | . | . | . | . | 30 | . | . | . | . | . | . | . | . | . | . | . | . | 45 |
| (?) | . | . | . | . | 9 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 9 |
| Cod and Bib, near, | . | . | . | . | . | 11 | . | . | . | . | . | 64 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 75 |
| Haddock, near, | . | . | . | . | . | . | . | . | . | . | . | 580 | . | . | . | 32 | . | . | . | . | 6 | . | . | . | . | . | 24 | 642 |
| Do. smaller than, | . | . | . | . | . | . | . | . | . | . | . | 38 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 38 |
| Cod and Whiting, &c., | . | . | . | . | . | . | . | . | . | . | . | . | . | 18 | . | . | . | . | . | . | . | . | . | . | . | . | . | 18 |
| Sprat and Poor-Cod, | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 750 | . | . | . | . | . | . | . | . | . | . | . | . | 750 |
| Cod, near, | . | . | . | . | . | 76 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 16 | . | . | . | . | . | . | 92 |
| Ling, | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 12 | 1 | . | . | . | . | . | . | . | 13 |
| | 1284 | 3684 | 1652 | 3104 | 170 | 269 | 173 | 290 | 3985 | . | . | 1533 | 37 | 123 | 828 | 157 | 1054 | 692 | 302 | 156 | 51 | 519 | 33 | 9035 | 177 | 46 | 138 | 29,492 |

## EXPLANATION OF THE PLATES.

### Plate XIV.

Fig. 1. Ovarian egg of turbot, 7th June 1891. × 24.
Fig. 2. Egg near topknot and turbot caught in the tow-nets in St Andrews bay, 9th July 1891. × 33.
Fig. 3. Egg of the same form, somewhat further advanced, with the embryo outlined, 8th July 1891. A group of vesicles appears near the centre. × 33.
Fig. 4. Egg of the foregoing form with the embryo fully half round the yolk, with the tail becoming free. × 33.
Fig. 5. Lateral view of the egg of the foregoing species so as to show the position of the oil-globule. The body of the embryo is merely indicated.
Fig. 6. Egg of the same with embryo far advanced, and with much pigment. The perivitelline space is larger. 25th July 1891. × 42.
Fig. 7. Sinistral post-larval (early) form, probably near top-knot. Spirit-preparation. × about 12.
Fig. 8. A similar form at a later stage, captured in St Andrews Bay, in the fresh (not living) condition. Enlarged.
Fig. 9. Post-larval form (brill ?) caught at the surface in St Andrews Bay, 11th July 1890. Enlarged.
Fig. 10. Sinistral post-larval form from deep-water (older stage than in fig. 7), 5 mm. in length. × about 12.
Fig. 11. A further stage of the same, 9·5 mm. in length, and with the left eye appearing on the ridge.
Fig. 12. Free ovum of the frog-fish, with the characteristic pigment of the embryo. × about 20.
Fig. 13. The same, to show the pigment round the oil-globule. Similarly magnified.
Fig. 14. Young brill (?), with 80 + dorsal rays, and otocystic spines, from Smith Bank, 5th July 1889.
Fig. 15. Unknown egg, with oil-globule and large perivitelline space. 8th July 1891. × 26.
Fig. 16. The same, on the 9th July 1891. Similarly magnified.
Fig. 17. Embryo further advanced (in the same egg), 10th July 1891. Similarly magnified.

### Plate XV.

Fig. 1. Unknown post-larval form, 9·5 mm. in length, resembling halibut. From Smith Bank, 28th June 1889.
Fig. 2. Larval long-rough dab (?), St Andrews Bay, 15th April 1892. × about 21.
Fig. 3. Egg of solenetta (*Solea lutea*), St Andrews Bay, 11th July 1890. *p.v.*, perivitelline space; *c.v.*, clear vesicle. × 52.
Fig. 4. Egg resembling that of the foregoing species, St Andrews Bay, 6th April 1892. *a*, protoplasmic investment; *z.r.*, capsule (*zona radiata*); *mic*, micropyle. × 52.

Fig. 5. Portion of the capsule (*zona radiata*) of the egg of the torsk, from the living species. × about 50.
Fig. 6. Portion of the same egg. × 500.
Fig. 7. Portion of the same capsule after desiccation in the open air. × 500.
Fig. 8. Egg of torsk, fertilised 21st May 1892. 25th May. × 57.
Fig. 9. Egg of the same species, 27th May 1892. Only a few pigment specks occur in tail. × about 50.
Fig. 10. Egg of the same, 28th May 1892. Black pigment is more abundant. × 57.
Fig. 11. Egg of torsk shortly before hatching. The greenish-yellow pigment is present on head and tail. × 57.
Fig. 12. Larval torsk of the first day (1st June 1892). × about 33.
Fig. 13. The same two days after (3rd June 1892). × about 44.
Fig. 14. Young torsk nearly a week old, 6th June 1892. × 26.

## Plate XVI.

Fig. 1. Egg of the sail-fluke (*Arnoglossus megastoma*), 28th May 1892. × 57.
Fig. 2. Egg of the same, with the rim beyond the equator, 29th May 1892. × 50.
Fig. 3. Egg of the foregoing after the formation of the lenses and the appearance of pigment in the embryo, 30th May 1892. × 57.
Fig. 4. Egg in which the tail of the embryo is free from the yolk, and the chromatophores are stellate, 30th May 1892.
Fig. 5. Newly hatched (and it is possible premature) larva of the foregoing, in which only black pigment is present. The peculiar character of the chromatophores of the marginal fin posteriorly is noteworthy. 1st June 1892. × about 26.
Fig. 6. A larva of the same species in more vigorous condition and somewhat older. The shape of the oil-globule, in lateral view, is interesting. 3rd June 1892. × 26.
Fig. 7. Larva of the sail-fluke on the 2nd June, viewed from the ventral aspect as it floated.
Fig. 8. Advanced larva of the same species, in which the canary-yellow pigment has appeared—with other structural changes. 7th June 1892. × 21.
Fig. 9. Ventral view of a dead larva to show the opening of the mouth and the opercular folds. 6th June 1892. × 85.
Fig. 10. Micropyle of the egg of the sail-fluke, with a radiate arrangement of ridges. × about 100.
Fig. 11. Micropyle (?) of the egg of the halibut. × 185.
Fig. 12. The same structure in another example of the egg of the halibut. × 185.
Fig. 13. Dead (but fresh) ova of the halibut about natural size. The opacity is caused by the collapse of the protoplasm.
Fig. 14. Egg of the brill undergoing segmentation. 24th May 1892. × about 57.
Fig. 15. Egg of the same at a more advanced stage. 25th May 1892. × about 57.
Fig. 16. Egg of the brill, in which lenses and pigment have appeared in the embryo. 27th May 1892. Similarly magnified.
Fig. 17. Portion of egg of the same at 4 p.m. on the 27th May showing Kupffer's vesicle. × about 57.

Fig. 18. Egg of the foregoing two days later, and with a great increase in both black and ochreous pigments. × about 57.

Fig. 19. Larval torsk of the second day, in which a diverticulum (*a*) was attached to the rectum. × about 33.

Fig. 20. Larval torsk with the mandible slightly projecting (though the mouth is not yet open). 1st June 1892. × 52.

Fig. 21. Tail of larval torsk to show the fan-like arrangement of pigment at the tip of the tail. 6th June 1892. × 85.

Fig. 22. Fine creases of the capsule (*zona radiata*) of the egg of the halibut. The densely arranged pores cover the general surface. × 185.

## Plate XVII.

Fig. 1. Melanotic tumour on tail of haddock, $\frac{2}{3}$ natural size.

Fig. 2. Section of the tumour showing pigment-corpuscles × about 400.

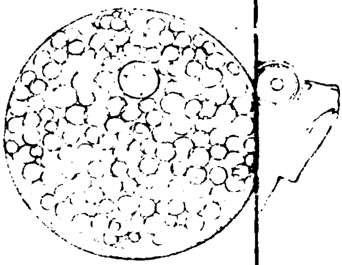
Fig. 3. Section of the same showing spindle-cells and blood-vessels × Zeiss Oc. 2, Obj. D.

Fig. 4. Section of wall of abdominal tumour of cod × 250.

Fig. 5. Left surface of abnormal plaice about natural size. The spots of black pigment have been omitted from the region of the abnormal fin.

PLATE XIV.

1



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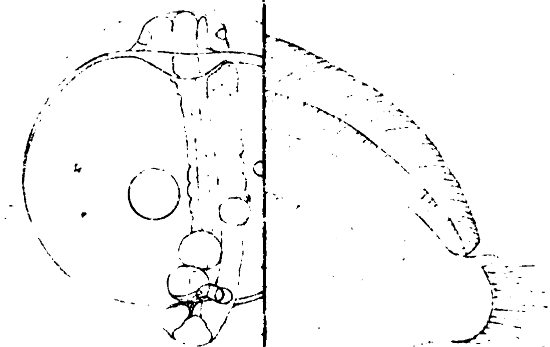

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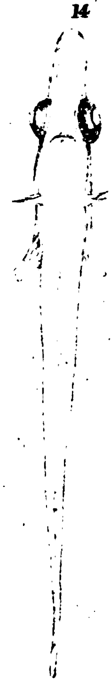

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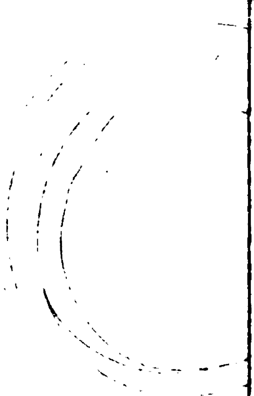

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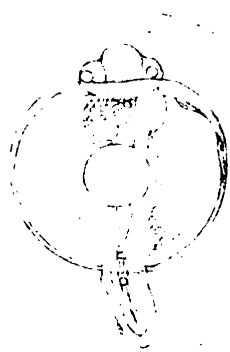

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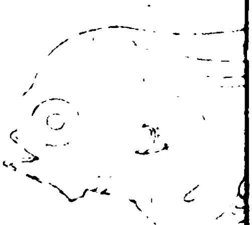
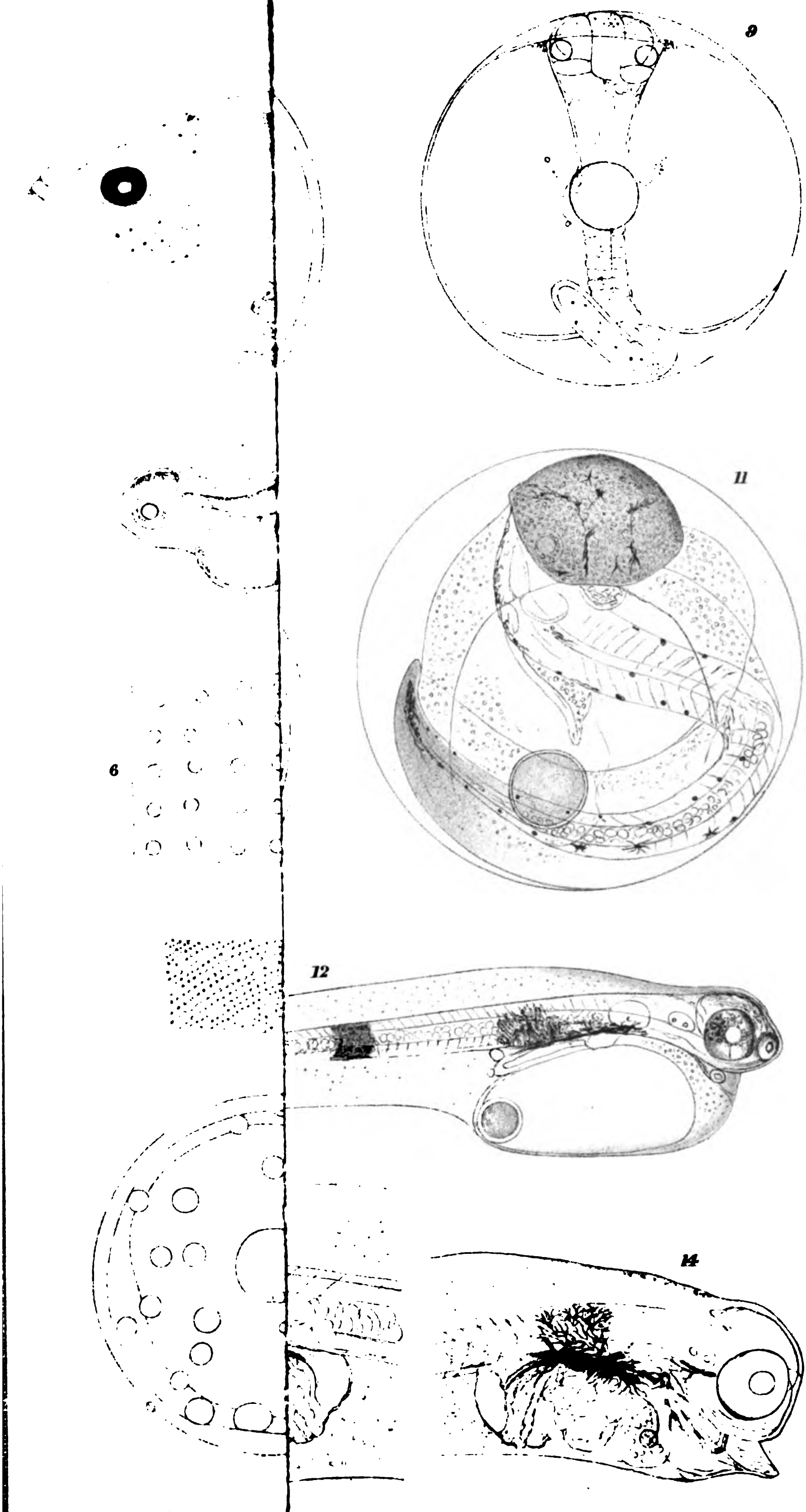


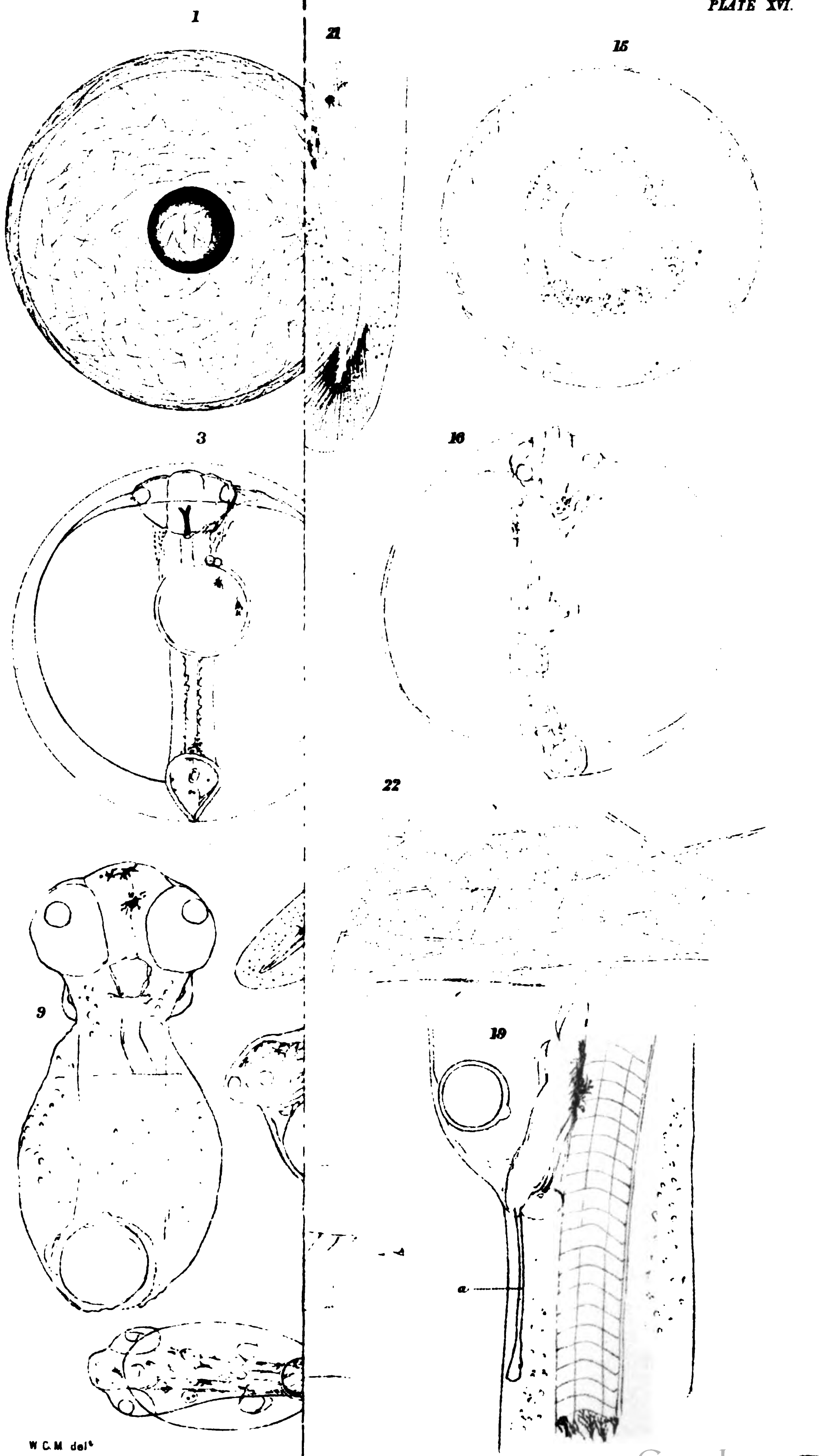
W C M del[t]

PLATE XV.




W. C. M del.

PLATE XVI.



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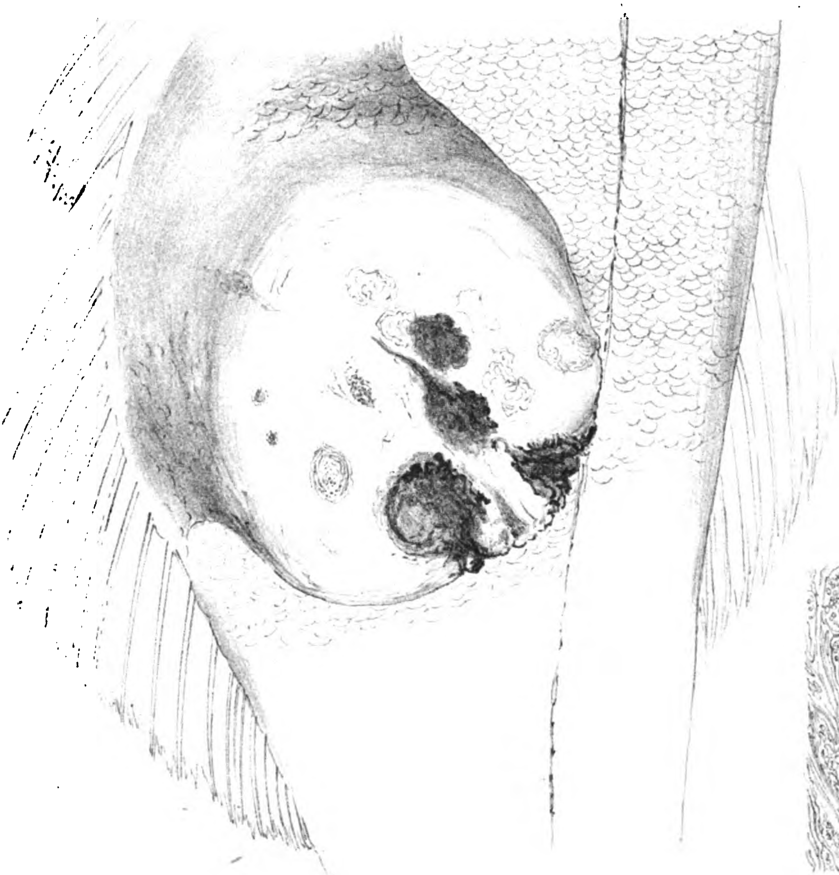

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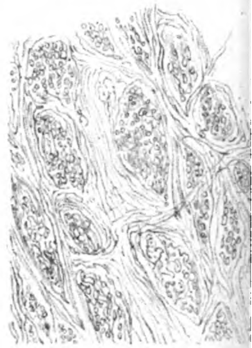

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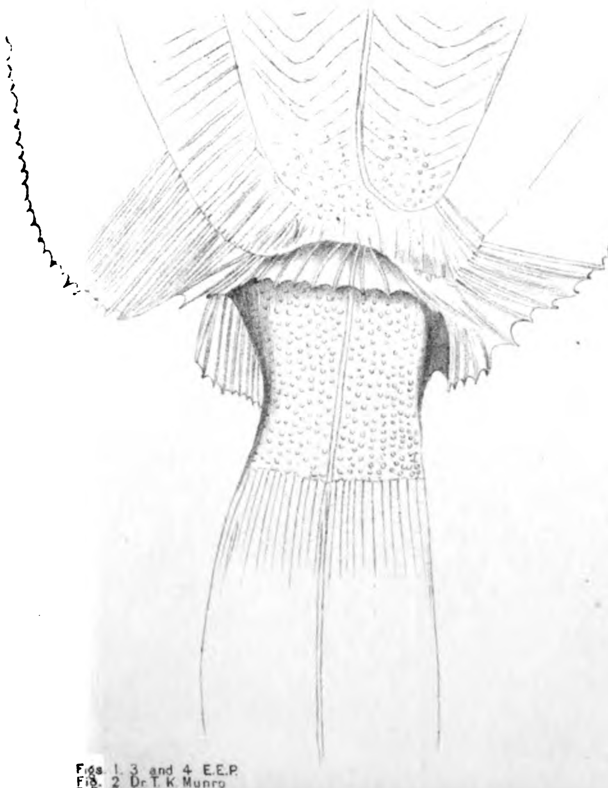

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Figs. 1. 3 and 4 E.E.P.
Fig. 2 Dr T. K Munro
Fig. 5 W.C.M.

## V.—ON TWO LARGE TUMOURS IN A HADDOCK AND A COD.
(PLATE XVII.)

I. Description of a Melanotic Tumour on a Haddock. By Professor Prince, B.A., F.L.S., St Mungo's College, Glasgow.
II. Microscopical Features of the same. By Dr. J. Lindsay Steven, Lecturer on Pathology, St Mungo's College, and Pathologist to the Royal Infirmary, Glasgow.
III. On an Internal Tumour from the Abdomen of a Cod. By Professor Prince.

On the 16th March 1892 a haddock, 2 feet long, was brought to the St Andrews Marine Laboratory with a large tumour on the side of the caudal trunk. The fish was thin and out of condition, the cranial bones being prominent, and the facies diagnostic. The surface of the tail on both sides behind the tumour was congested, resembling in colour a red mullet. The specimen was a female, with the ovaries approaching maturity. The liver was pale and atrophied. The ulcerated surface of the tumour presented in the fresh condition masses of pigment and multitudes of small cells with fibroid streaks here and there.—[W. C. M.].

### I. DESCRIPTION OF THE TUMOUR. By PROFESSOR PRINCE.
(Plate XVII. fig. 1.)

The tumour, which projected from the caudal trunk about half an inch below the lateral line, had the form of a short stout cylinder. Its posterior margin was 6 inches from the middle of the free edge of the caudal fin. The caudal fin itself was seriously abraded, and had evidently been worn away greatly by contact with the sea-bottom. At its base the tumour was $7\frac{3}{4}$ inches round, and about the same in circumference at the upper margin. It was 2 inches in height, and much of the surface was ulcerated and presented a reddish raw appearance. Extensive black patches occurred towards the dorsal side, one, anteriorly, measuring $\frac{7}{16}$ in. × $\frac{5}{8}$ in., another $1\frac{1}{2}$ in. × $\frac{3}{4}$ in., and the third, towards the upper posterior edge, measured $1\frac{1}{8}$ in. in diameter. Around the base of the tumour the scaly integument was raised up, but the silvery appearance ceased at $\frac{1}{2}$ inch to $1\frac{1}{2}$ inches from the rim, and the flesh-coloured corium continued to the ulcerated surface. The tumour, in pushing its way outward, thus left the layers of the integument behind, and naked cutis alone occurred at the flattened top. Digital examination showed that it did not penetrate the muscles of the interspinous bones beneath, though it lay immediately above the first anal fin, and trenched for a distance of $1\frac{1}{2}$ inches upon the base of the second anal fin. The latter fin was not displaced from its normal median position, but the first anal was pushed so far from its place as to impart to the caudal trunk a flattened face on the side opposite the tumour. All the neighbouring tissue showed a congested appearance, but the muscles mainly affected were those forming the left ventral band, *i.e.*, the imperfect lower investing cone. Little dissection was made in order to keep this curious pathological specimen in an uninjured state, but examination sufficiently showed that the tumour was seated upon the surface of the caudal muscles and enveloped mainly by the corium. To the touch the tumour was very hard, and on account of

its position had evidently seriously impeded the movements of the tail, the lower lobe of the caudal fin, as already stated, being considerably lacerated—an irregular triangular piece about 2 inches across the base and 2 inches in height having, in this way, been removed.

## II. Microscopical Features of the Tumour. By Dr J. Lindsay Steven.

The naked eye appearances of the tumour, which was of the size of a small apple, were those of a melanotic sarcoma. Its ulcerated surface showed intensely black areas, in the midst of white tissue, of a gelatinous character. A thin slice was taken from the interior, and hardened in absolute alcohol. Sections were made, and these were examined unstained and stained in Picro-Lithium Carmine, Logwood, and in Eosine and Logwood double stain.

In section the pigmented and non-pigmented areas were sharply defined, though branching pigment corpuscles occasionally passed over the lines of demarcation. The branched corpuscles in the non-pigmented parts had an appearance suggestive of delicate tubular spaces in which the granules were massed, the spaces ramifying between the cells of the tumour. So dense was the aggregation of black corpuscles in the dark areas that the sections were quite opaque, and transmitted light could only at occasional points be seen to penetrate them. At the margin of these areas the coloured corpuscles appeared to be somewhat stellate, as shown in the drawing (Plate XVII. fig. 3) made by Dr T. K. Monro, with the aid of the camera lucida, and were of an inky blackness. In the midst of the densely pigmented areas, moreover, appearances were seen which suggested the presence of delicate tubular spaces, in which the colouring matter was accumulated.

The non-pigmented portions exhibited thin-walled blood vessels containing nucleated oval corpuscles, and ramifying in all directions: but the main mass of the tumour consisted of small spindle-shaped cells (Pl. XVII. fig. 2) nucleated, and in some areas arranged in parallel rows, not unlike fibrous tissue. Some cells were rounded rather than spindle-shaped: but the tumour may, on the whole, be described as a small spindle-celled melanotic sarcoma.

## III. On an Internal Tumour from the Abdomen of a Cod. By Professor Prince.

A remarkable tumour from the perivisceral cavity of a large cod was received at the St Andrews Marine Laboratory on May 30th. It weighed no less than $15\frac{1}{4}$ oz., though it was in a partially dried condition, having been procured two days previously.

It was of a yellowish-white colour, extremely smooth, and not unlike a small bladder of lard in appearance. In shape it was rudely pyriform, 10 inches in circumference at the widest part, and over $5\frac{1}{4}$ in. long. No scar or evidence of attachment was perceptible on its exterior. At the narrow end a round terminal depression occurred, and deep furrows appeared upon the sides, four of these exhibiting apertures from which red mucus was exuding. The other depressions were evidently slits recently closed, and these could be readily opened by inserting the handle of a scalpel. Upon dissecting away part of the wall, which was of a dense white fibrous nature, more compact externally and forming an inseparable outer cuticle, the

interior cavity was found to be fully occupied by a hard reddish mass of very irregular form. The fibrous capsule formed an exact mould around the contained mass. The latter was composed of congealed blood, dense fibrous cartilage, and muscular tissue ; for the presence of which, amongst the abdominal viscera, it is difficult to account.

Much reddish mucus occurred in the cavity of the tumour. Sections of the fibrous capsule showed that it was made up of a close meshwork of fibres, with interspaces occupied by round cells and granular matter Pl. XVII, fig. 4). Its optical appearance was that of white fat, but no fatty globules appeared in it, and it was non-vascular.

The capsule varied greatly in thickness, from $\frac{1}{2}$ an inch to over $1\frac{1}{2}$ inches. The tumour was evidently a connective-tissue capsule formed around a foreign body in the perivisceral cavity : this foreign mass, like a large fragment of undigested food, lying outside the walls of the alimentary canal.

## DESCRIPTION OF FIGURES.

### Plate XVII.

Fig. 1. Melanotic tumour on haddock, slightly reduced sketch.

Fig. 2. Section of melanotic tumour showing pigment-corpuscles. × about 400.

Fig. 3. Section of melanotic tumour showing spindle-cells and blood vessels. Zeiss Oc. 2, Obj. D.

Fig. 4. Section of wall of internal tumour of cod. ×250.

# SECTION C.—CONTEMPORARY WORK.

## AN ACCOUNT OF CONTEMPORARY SCIENTIFIC FISHERY WORK AND FISHERIES IN THIS AND OTHER COUNTRIES. By DR T. WEMYSS FULTON, F.R.S.E., Secretary for Scientific Investigations.

In the following pages I have brought together and summarised the information available as to the present condition of the sea fisheries in the more important countries which possess sea fisheries and fishery departments, and the various means being employed for their conservation and improvement. This has been possible only by the generous co-operation of those engaged in fishery work in this country and abroad.

The chief points brought out in this comparative study of contemporary fisheries are:—

1. A general complaint of the depopulation of territorial and inshore waters from over-fishing. This complaint is made in all the States whose territories border the North Sea, namely, Norway, Denmark, Germany, Holland, Belgium, France, and England, as well as in Scotland. Similar complaints are made on the Mediterranean coast of France, in Spain, Italy, and in America and elsewhere.

The measures proposed or adopted to meet this diminution are (1) the total or partial prohibition of certain modes of fishing deemed injurious; (2) the enforcement of close times; (3) prohibition of the capture, landing, or sale of immature fish; (4) protection of spawning grounds; (5) the destruction of the enemies of the food fishes, as seals, porpoises, &c., in certain continental fisheries; (6) the establishment of hatcheries on the coast for sea fish and edible shell fish.

Examples of these may be found below. Regulations regarding immature fish exist in Denmark, France, and Italy; similar regulations are proposed in Belgium and Holland. Sea fish hatcheries exist in the United States, Newfoundland, Canada, Norway, and Scotland, and it is proposed to establish them in Belgium and France. In Newfoundland last season 551,469,000 young lobsters and 39,650,000 young cod were hatched and planted on the fishing grounds; this season 207,000,000 young cod were hatched in Norway and planted in the inshore waters.

2. The extension and organisation of scientific investigations in connection with fisheries. During last year vessels have been engaged in making explorations of the fishing grounds of various countries. The expeditions on similar work off the west coast of Ireland have been completed, and the Belgian authorities propose to equip their fishery cruiser in order to undertake work like that done by the 'Garland.' A number of marine laboratories have been established. There is one in Italy, one in Austria-

Hungary, eleven or twelve in France, one in Holland, one in Denmark, and several in the United States. The German Government have erected one at Heligoland in connection with their North Sea fisheries, which has been placed under the direction of Dr Heincke, so well known in connection with his researches on the herring, with Dr Ehrenbaum as assistant.

One cannot but be impressed by the energetic efforts being made by the various governments to organise, conserve, and promote their sea fisheries in every way possible, and to acquire and diffuse information from other countries likely to prove beneficial. In many countries periodic official reports are obtained from abroad, and many missions of inquiry are made, especially perhaps to this country.

I have to thank many foreign fishery authorities for assistance in this department; not merely in supplying reports and publications referring to their work, but in furnishing, promptly and readily, all information in their power on points submitted to them

Among these I may mention M. Raveret-Wattel, Secretary to the Societé d'Acclimitation de France; Dr P. P. C. Hoek, Scientific Superintendent of Dutch Fisheries; Captain Drechsel, the Superintendent of Danish Fisheries, and the Naturalist Dr Petersen; Professor Pouchet, the Director of the Concarneau Laboratory; Professor Marion, the Director of the Laboratoire d'Endoume, Marseille; Captain Dannevig, the Superintendent of the well-known hatchery at Flödevig; Señor Rafael Gutierren Vela, of the Spanish Fisheries Department; Sir Charles Tupper, the High Commissioner for Canada; Mr Nielsen, the Superintendent of the Newfoundland Fisheries; Professor Giglioli, of Florence, Fishery Commissioner; His Highness Prince Albert of Monaco; Baron Jules de Guerne and M. Jules Richard; Drs Malm and Lundberg, the Inspectors of Swedish Fisheries; Dr Sauvage, Director of the Marine Station, Boulogne-sur-mer. Among those at home who have been always willing to co-operate, I must specially mention Sir Thomas F. Brady, the Inspectors of Irish Fisheries, and Professor M'Intosh, F.R.S.; also Mr W. L. Calderwood, the Director of the Marine Biological Association's Laboratory at Plymouth; Mr Ernest W. L. Holt; Mr Olsen, Secretary of the Grimsby Marine Fisheries Society; and Mr J. Wrench Towse, the Honorary Secretary to the National Sea Fisheries Protection Association.

I have also to thank Mr F. G. Binnie for assistance in translating a number of the foreign reports, and Mr W. Anderson Smith for the abstract of the Spanish Reports, which is included below.

## I. UNITED KINGDOM.

### 1. Great Britain.

Since the Ninth Report appeared, two numbers of the *Journal of the Marine Biological Association* have been published.*

In the first number there are several important papers. Mr J. T. Cunningham describes the ovum and larva of *Callionymus lyra*, the reproduction and growth of the pilchard, and the rate of growth of some sea-fishes, and their distribution at different ages. In the latter paper the results of a large number of observations are given, dealing with the flounder, the plaice, dab, lemon sole, sole, little sole, thickback (*S. variegata*), turbot, brill, scald-back (*Arnoglossus laterna*), whiting, pollack, bib, &c. Generally speaking, Mr Cunningham's observations regarding

* *Jour. Marine Biol. Assoc.*, vol. ii, Nos. 2 and 3, 1892.

the distribution of immature flat fishes agree with those made on board the 'Garland.' The author discusses the question of the protection of immature fish, and inclines to the view that certain fish should be protected until they have reached a size above the minimum size at which maturity is attained.

In the second of these are a number of papers dealing with marine biology, physics, and sea fisheries. Mr Calderwood, in his report, reviews the work of the Association, and refers to the investigations being carried on by Mr Holt at Grimsby, in connection with the North Sea Fisheries, the objects of which are (1) to prepare a history of the North Sea trawling grounds and their present condition, with their condition twenty or thirty years ago; (2) to continue, verify, and extend observations as to the average sizes at which the various food-fishes become sexually mature; (3) to collect statistics as to the quantity of immature fish captured annually; (4) to make experiments with beam trawl-nets, with meshes of different size, to ascertain the relation between size of mesh and the size of the fish captured. Mr Holt furnishes a paper with a brief account of the method of his investigation, and some of the results obtained—giving limits for dividing large and small fish, comprising 22 species, among them the following:—Turbot, 17 inches; brill, 15; sole, 12; lemon-sole, 10; plaice, 17; halibut, 23; witch, 12; megrim (*Arnoglossus*), 12; sand-dab, 6; long rough dab, 6; flounder, 7; cod, 20; haddock, 10; whiting, 8; coal-fish, 20; hake, 24; tusk, 16; gurnard, 9; cat-fish, 20.* Tables are given of a number of fish examined in January, February, and March. There is a paper by Mr Hughes on the continuation of the experiments on artificial bait; there has been, up to the present, little or no success, the great difficulty being to discover a suitable medium for the retention of the organic extracts.

Mr J. T. Cunningham gives an important paper 'On the Rate of 'Growth of some Sea-Fishes, and the Age and Size at which they begin 'to Breed,' treating of the cod, flounder, common dab, sole, mackerel, herring, sprat, pilchard, anchovy, and shads. This research has been carried on partly by observations on fish of different sizes taken from the sea, in relation to their spawning time, and partly on specimens reared in tanks, the results and views of other observers being also discussed. No new light is thrown upon the rate of growth of the cod; the earliest period at which sexual maturity is reached is uncertain. The measurements of flounders reared in the tanks are given; the largest specimen known to be two years of age was 26·7 cm. long, or 10·5 inches, and the smallest only 7·2 cm. or 2·8 inches. Cunningham reasonably conjectures that this difference is due to artificial conditions, although it may possibly sometimes occur in nature. None of the flounders attained sexual maturity during the first year, and only 19 per cent. in the second year; and the inference is that the majority breed when three years old. Of the specimens which became mature, 13 were males, and 4 were females; but the observations extend only up to the end of March. The smallest ripe male was 6·4 inches and the largest 9·2 inches; the smallest ripe female was 8·4 inches and the largest 10·5. Cunningham infers that in order to exclude all immature individuals, a limit of size must be taken which is above the minimum size of mature females. It appears to me that too much stress may be laid upon results so obtained; although it must be said the investigation of the rate of growth is as difficult as it is important, and in the absence of tidal ponds, such as Dannevig possessed, there is scarcely any other mode possible. If the fish is marked and returned to the sea, it is injured, and the natural rate of growth cannot

* Compare Table V. at page 238 of the present Report.

be determined; if it is reared in captivity, artificial conditions are imposed, which may have the result quoted above, of producing fish three or four times smaller than others of the same age. And artificial influences probably affect the reproductive organ profoundly—since Darwin and others have shown that this organ is in the highest degree susceptible to such influences. Mr Cunningham has checked his results as far as possible by comparison with specimens taken from the sea. The common dab does not appear to breed during the first year. The mackerel, herring, sprat, and anchovy appear to reach sexual maturity when two years old. In the same journal, Mr Holt describes specimens of *Centrolophus pompilius* from the coast of Cornwall; and Mr W. L. Calderwood gives the results of experiments on the relative abundance of anchovies off the South Coast of England. Mr Calderwood also furnishes monthly reports on the fishings in the neighbourhood of Plymouth, and Mr H. N. Dickson reports on the physical observations.

The Marine Biological Station of the Liverpool Marine Biology Committee, of which Professor Herdman, F.R.S., is Director, was recently transferred to Port Erin, in the Isle of Man. Professor Herdman and his colleagues have practically exhausted by their labours the faunistic resources in the neighbourhood of Puffin Island, and it was decided to transfer the field of operations to comparatively virgin soil at a distance from the mainland. In the Fourth Annual Report,* Professor Herdman describes the investigations made in 1890. Lists of collections are given, and further observations on the protective colouring and edibility to fish of nudibranchs, and on the protective colouring of a crab (*Porcellana platycheles*), and a worm (*Eulalia viridis*). Mr F. G. Pearcey furnishes lists of the Foraminifera dredged in Liverpool Bay. Professor Herdman has a brief but interesting paper on shrimps. He circulated a set of inquiries among fishermen and others at various neighbouring places, with blank spaces to be filled up monthly as to the relative abundance, size, presence of immature forms, presence of eggs, &c., and the results are given in a table. Professor Herdman has also published recently† the biological results of the cruise of the 'Argo' round the West Coast of Ireland last year. Lists of the organisms contained in the tow-nets, dredge, and trawl, are given, and also an account of the sponges by Dr Hanitsch. In the Fifth Annual Report the work done at Puffin Island is described. A list is given by Mr A. O. Walker of species of Crustacea new to the district, including *Nyctiphanes norvegica* and many others. Professor Herdman gives some very interesting observations on the habits of the common limpet. The enquiries, referred to above, into the life-history and habits of the common shrimp have been continued, the results confirming those of the previous year. The food matters generally attributed to the shrimps are worms, dead fish, sweet cockles, 'stones 'and shells, and finally "suction."' Their worst enemies appear to be crabs (*Carcinus mœnas* and *Polybius henslowi*) and fishes, especially whiting, young cod, haddock, small cod, skates, and flukes. In discussing the question of shrimp fishing, Professor Herdman refers to the capture and destruction of immature fish; and he suggests the propriety of endeavouring to increase the supply of shrimps by artificial cultivation.

Dr Hugh Robert Mill has recently published an elaborate and exhaustive report on the physical geography of the Clyde Sea Area,‡ an area which

* *Fourth Ann. Rep. Liverpool Marine Biol. Station on Puffin Island*, Liverpool, 1891.

† *Trans. Biol. Soc. of Liverpool*, vol. v. p. 181.

‡ *Trans. Roy. Soc. Edin.*, vol. xxxvi. part iii. No. 23, 1892.

has for several years past been very carefully investigated by Dr John Murray, Director of the 'Challenger' Commission in the steam-yacht 'Medusa.' Dr Mill carried on investigations into the temperature, density, and salinity of the sea-water in the Clyde area during the years 1886, 1887, 1888, and 1889. He describes in detail the physical geography of the district—the drainage areas and rainfall, the latter of which is considered most exhaustively. There are chapters on the temperature of the air, the salinity and chemical composition of the water, and on the temperature of the latter. There are twelve plates illustrating the paper.

The British Association for the Advancement of Science recently issued the fourth and final report of the committee appointed to arrange an investigation of the seasonal variations of temperature in lakes, rivers, and estuaries in various parts of the United Kingdom; the report being drawn up by Dr H. R. Mill, who acted as secretary. The main object—the production of an authoritative and exhaustive memoir on the seasonal variations of temperature in inland waters and estuaries—had to be abandoned; but the report contains information of considerable value in relation to lakes and rivers. A great number of observations are referred to, including those carried on by the Fishery Board for Scotland.

The Sixth Annual Report of the Inspectors of Sea Fisheries of England and Wales, dealing with the year 1891, was issued lately.* In accordance with the formation of Sea Fisheries Districts around the coast, under the Fisheries Acts of 1888 and 1891, a considerable part of the volume is taken up with this subject, and a very instructive coloured map is given, showing the districts now formed and their limits. From this it appears that ten Sea Fisheries Districts, comprising a large part of the coasts of England and Wales, have been formed. On the East and South Coasts considerable areas have as yet not been formed into districts. The powers conferred upon the Local Sea Fisheries Committees by the Acts above referred to are extensive. The committees can close mussel and oyster beds by bye-law instead of by the more complicated and expensive machinery of a Regulating Order; they can by the same mode determine, with regard to any specific area, the methods of fishing and the instruments which may be used, and the form and size of such instruments; they can prohibit the deposit of deleterious substances, and can either fix an annual close season or can close beds in rotation for a specific number of years. By obtaining a Regulating Order under the Act of 1868, they can fix the minimum sizes for mussels and cockles, receive powers to plant beds, to make bye-laws, &c. A great number of bye-laws have been passed by various District Committees on these lines.

It is stated that the total take of sea-fish during the year has been slightly less than in 1890, the decrease being in great measure due to stormy weather, and having occurred chiefly in herrings and mackerel. Prime fish show a small increase; crabs, lobsters, and oysters a decrease; but the total value is higher than in the previous year.

The increase in steam-trawling on the North-East Coast is described as remarkable. At Shields, Hull, and Grimsby several large new screw-trawlers have been added to the fleets. At Hull the number of steamers has been doubled during the year, and at the same time there has been a considerable decline in the number of sailing trawlers. At Boston the steam fleet has also been increased. It is pointed out by Mr Malan that this great increase in catching power does not seem to have improved the fisheries, a falling off in the catch of mature plaice having occurred. Hun-

* *Sea Fisheries (England and Wales) Sixth Annual, Reports of the Inspectors* (for 1891), London, 1892.

dreds of tons of undersized plaice appear to have been caught and destroyed off the Dutch, German, and Danish coasts. Steam is being introduced into the great cod-fisheries carried on from East Coast ports, and cod-fishing by sailing vessels will probably decline at Grimsby, which is the great centre of this trade. As yet there are only 17 steam 'codmen' as against 100 sailers. The quantity of wet-fish landed was 5,966,076 cwts., compared with 6,100,630 cwts. in 1890 and 6,466,564 cwts. in 1889. The values in these three years respectively were £4,491,018, £4,368,552, and £3,862,389 in 1889. The number of registered boats was 8063, of which 3873 were first-class, having each a tonnage of 15 tons or over. Besides the registered boats, there are a large number of open boats. The number of men and boys constantly employed is estimated at 33,044.

It is stated that during the last few years there has been a remarkable change in the character of the large vessels engaged in the fisheries, especially on the East Coast. Iron is taking the place of wood, and sails are giving way to steam. At the same time, several ports which, until recently, were scarcely considered as fishing stations, now send fleets of steam-trawlers into the North Sea. Mr Malan shows in a table that while in 1882 only 5 fishing vessels were built of iron as compared with 67 of wood, at the two ports of Hull and Grimsby, in the year 1891 there were 112 built of iron and only 15 of wood. It appears that the fish-supply to London has been falling in recent years; in 1887 the quantity was 170,463 tons; in 1888, 180,997 tons; in 1889, 173,545 tons; in 1890, 165,852 tons; and in 1891, 164,557 tons. Mr C. E. Fryer deals chiefly with the mussel and oyster fisheries; and there are a number of appendices and special reports. The Thirty-First Annual Reports of the Inspectors on the Salmon and Fresh-water Fisheries during 1891 was also recently issued.*

The fourth edition of a pamphlet 'On Stocking Rivers, Lakes, Ponds, 'and Reservoirs with Salmonidæ,' by Sir James Maitland, Bart., was recently published.† It contains chapters of great interest and value on the production, incubation, cost, &c., of ova; on fry, yearlings, two-year-olds, redds, ponds, &c. Full details are given in all the chapters on the various matters with which they deal; and the information will be of great service to the large and increasing number who engage in fish culture.

## 2. Ireland.

In last year's Report (p. 394), it was stated that a survey of the fishing grounds on the West Coast of Ireland had been undertaken conjointly by the Government and the Royal Dublin Society;‡ and the Report of the Rev. W. Spotswood Green, Inspector of Irish Fisheries, who was the Director of the survey on the first year's expedition, was referred to. Since then a very full report by Mr Green, has been issued by the Royal Dublin Society, and by the Inspectors of Irish Fisheries in their Annual Report, dealing with both expeditions, and especially that of 1891. The sea fisheries on the West Coast of Ireland, like those on the West Coast of Scotland, have frequently formed the subject of inquiry, and have led to a variety of proposals for their advancement. Mr Green states that the old records contain data for a complete history of the question, but

* *Salmon and Fresh-water Fisheries (England and Wales), Thirty-First Annual Reports of the Inspectors of Fisheries (England and Wales) for* 1891, London, 1892.

† J. R. Guy, Secretary, Howietoun Fishery, Stirling, 1892.

‡ *Report of the Council of the Royal Dublin Society for* 1891, Dublin, 1892, p. 23, *et seq.*

that their study is disheartening, since one seems now, in writing a report anew, to be only treading ground that has been traversed over and over again. The same may be said regarding the sea fisheries on the West Coast of Scotland: for centuries pamphlets and books have been issued as to the 'mines of wealth' in the western seas; but the proposals for working these mines have almost invariably involved State aid—thus contrasting strongly with the conditions under which the East Coast fisheries were developed. It is pointed out that in recent times changes in the circumstances have occurred—the more important being the extension of railways, steam lines, and telegraphic communication. The survey of 1891 was conducted on board the steamer 'Harlequin,' hired for the purpose, actual operations beginning on the 21st March and terminating on 4th June. During this period a great number of important fishing grounds, some of these little known, were examined, and the various appliances of fishing—beam-trawl nets, drift-nets, lines, dredges, tow-nets, &c., were employed in the investigation. In his report Mr Green gives details of the various examinations and experiments made. On the south of Ireland, cod and ling appear to migrate from east to west; in the Irish Sea, northwards, while off the West Coast, they seem to pass merely from deeper to shallower water, and *vice versa*, the fish being obtainable at all times off the same part of the coast. The best grounds for prime flat-fish, such as turbot and soles, are the bays, from March to September, and probably to November. In March they are found in about 30 or 40 fathoms, and move inshore later. Plaice seem to move in shoals, the large fish keeping more or less together. When the large plaice quit a certain ground, a certain number of small and medium-sized fish are left, which appear to remain constantly on the ground. From the experiments made, Mr Green believes that haddock, ling, hake, and, perhaps, also cod, are to be found over the vast area between the coast and the 200 fathom line, which in one direction is 200 miles from shore; and the abundance of fish food near the bottom was found to be very great. Chapters are devoted to bait and the development of the various kinds of fisheries. It is pointed out that gurnard and bream are the favourite food of the people, who rarely eat flat-fish, and never think of touching skate and ray, which are abundant, and would in other countries be looked upon as a valuable food supply. Lobster fishing is an important industry on the West Coast (as well as kelp-burning), the prices ranging from about 10s. a dozen at the beginning of the season, to 7s. or so, later, welled-smacks coming from Southampton for cargoes. The fishermen frequently carry their pots in their 'curraghs' or 'pookawns,' to fish on other parts of the coast. There are very interesting chapters on the fishing boats used on the West Coast, the harbours, and the people.

The scientific results of the expedition are described by Mr Ernest W. L. Holt, the assistant naturalist to the survey, in a series of admirable reports,* which form an important addition to the literature concerning sea fisheries. Lists are given of all the species of fish obtained; of the stations, with locality, date, soundings, &c.; the nature of the fishing implements employed, with lists of the fishes and the invertebrates captured, so far as the latter have been identified. The number of mature and immature fish in each haul is shown, tables being given as to the limits of size upon which the distinction is based. Schedules follow, showing the exact numbers, sizes, weight, condition of reproductive organ, and contents of stomach of all the more important kinds of fish. Tables are also given of the temperature and density observations taken. In addition, experiments to test the comparative efficiency of different baits

* *Op. cit.*, pp. 73–329.

used in long-line fishing were carried on, and also experiments on the effect of different nets upon the capture of immature fish.

In dealing with these various important questions and inquiries, Mr Holt has discussed the results in very full detail. The spawning periods and the distribution of spawning fish on the west coast of Ireland are set forth in a valuable series of tables, and they are described for each species of fish—some 70 in number. In a chapter on the definition of immature fish, Mr Holt has defined the limits of immaturity for a great number of species, comparing these with the sizes fixed upon at the Fishery Conference and by the writer. These definitions include, for the first time, the limits for the males and females of each species, and not merely for ripe fish, irrespective of the sex; and Mr Holt advances reasons why, in framing regulations, the size of the female at maturity should be taken as a guide, and not that of the male, which appears to be invariably smaller.

The distribution of mature and immature fish is also given on the above basis of distinction, so far as concerns the depth of water or vertical distribution; it having been found impossible, from the broken nature of the coast, to group the facts profitably in relation to territorial and extra-territorial waters. There are also chapters on the food of fishes, on unsaleable fishes, and on measures for the protection of immature fish, and the increase of the fish supply. Mr Holt advocates measures for the protection of immature fish, and points out that if a relationship can be established between the size of the mesh in trawl-nets and the size of the fish captured by them, much good might be done by restriction of the size of mesh, combined with prohibition oi the sale or possession of fish under a certain size, and that even more beneficial results would be likely to follow were it possible by any means to restrict the time during which a trawl should be allowed to be on the ground, especially on trawling grounds which are known to be haunted by young fish. While of opinion that a close-time for marine fish is not very practicable as a general rule, he thinks that under certain conditions restricted measures of a limited nature might be beneficially exercised.

Mr Holt points out that the final resource lies in the artificial rearing of fish, as in the United States, and elsewhere.

The result of this survey of the fishing ground on the west coast of Ireland, while of immediate importance in relation to the area investigated, will, beyond doubt, have great value to those engaged in fishery inquiries—now a large and increasing number—in all other States. There is one observation that may be made, considering the limited time during which the investigation was carried on, and that is that their utility would have been greatly increased had they been continued for a few years longer.

The Report of the Inspectors of Irish Fisheries for 1891 was recently issued, being the twenty-third since the Sea and Inland. More detailed information than heretofore was obtained as to the vessels, men, and boys engaged in fishing around the coast. The registered and unregistered boats, and the men, fishing for sale, were 5950 vessels, 22,172 men, and 788 boys; or, including those not fishing for sale, 6415 vessels, 23,260 men, and 788 boys. Of the boats in the latter case, 444 were first class. Twenty-six Irish boats left for the Scotch herring fishing last year. The statistics of fish captured are not complete; so far as ascertained, they were 621,394 cwts., of the value of £301,885. In addition, shell-fish valued at £13,069 were landed. In describing what has been done in

* *Report of the Inspectors of Irish Fisheries on the Sea and Inland Fisheries of Ireland for* 1891. Dublin, 1892.

regard to loans for fishing boats and gear, it is stated that, since the assets of the Irish Reproductive Loan Fund began to be administered by the Inspectors, seventeen years ago, loans have been made amounting to £104,297. The arrears are only £3613, 10s. 9d., and of these, £2590, 9s. 11d. are 'recoverable'—the amount 'irrecoverable' for the seventeen years being £1023, 0s. 10d., or less than 1 per cent. Another charitable fund administered by the Inspectors is the Sea and Coast Fisheries Fund. Since 1884 loans to the amount of £40,223 have been made. The amount of 'bad debts' is only £9, 6s. 8d. The Inspectors point to these figures as evidencing the honesty of the Irish fisher-folk; and state that these funds have been the means of keeping alive the fishing industry on the western seaboard.

Since the date of the previous Annual Report, a number of bye-laws have been passed, prohibiting steam trawling in certain bays and territorial waters.

Various tables and particulars are given of the quantities and values of the fish landed, so far as they are indicated by the statistics. One feature is noticeable, namely, the number of English, Scotch, and Foreign boats that take part in the Irish fisheries. Thus, in the Spring herring fishing, 206 boats from the Isle of Man, England, and Scotland, were engaged (the Scotch numbering 161), along with 1086 native boats. In the mackerel fishing the proportion of 'foreign' boats was much greater. Of a total of 650 boats engaged, 373, or more than half, were stranger or foreign, viz., 289 English and Manx, 16 Scotch, and 68 French. The importance of the Irish mackerel fishery is evident from the figures of the quantities and value of the fish caught. Last year the quantity was 308, 581 cwts., realising £149,617. In the previous year the quantity was 501,943 cwts., valued at £218,672. The quantity of herring landed was 102,920 cwts., valued at £39,327. The Inspectors give instructions for the curing of mackerel, which they intend to publish separately in pamphlet form; and an expert from Norway was engaged to give instructions in mackerel curing during the season of 1891. The Report contains other statistical tables, reports from the coastguard divisions, &c., and also deals with the salmon fishings.

## II. CANADA.

Two reports have been published by the Canadian Fisheries Department referring to the year 1890; one dealing with the financial statements for the fiscal year and general questions,* and the other with operations in fish-breeding.† A third report, dealing with the statistics of the fisheries, appears later. The total expenditure for the fiscal year was 328,748 dols., the appropriations having been 383,300 dols. Of this amount, 39,126 dols. was spent in connection with fish-breeding operations, 64,434 dols. in the fisheries protection service, and 149,999 dols. as fishing bounties. The revenue of the department amounted to 56,976 dols., arising from rents, license fees, and fines. The bounty system appears to be of an elaborate nature; the payments are made under an Act of 1882, entituled, 'An Act to Encourage the Development of the Sea 'Fisheries and the Building of Fishing Vessels,' which authorises an expenditure annually of 150,000 dols. (about £31,000) for this purpose.

* *Annual Report of the Department of Fisheries, Dominion of Canada, for the year* 1890, Ottawa, 1891.

† *Report on Fish-breeding Operations in the Dominion of Canada*, 1890, Ottawa, 1891.

In 1889, the last year for which statistics are given, 17,078 claims were paid; the amount paid, on the basis of 1½ dols. to vessels, and 3 dols. per man to boat fishermen, was 158,526 dols., which included claims for 1888 held in abeyance. The number of vessels which received bounty in 1889 was 833, with a tonnage of 32,716 tons, and the number of boats 16,230; the number of fishermen receiving bounty being 31,525. The total number of fishermen in vessels and boats who received bounties in 1889 was 38,343. Since the year 1882 the total amount of bounty paid has been 1,253,262 dols.

As might be expected from the vast area of the Dominion and the extent of its fisheries, many matters are described in the Report which can merely be touched on here. The fisheries for white fish in the great Lake Winnipeg, complicated by circumstances connected with the Indians, who fish in it, are found to be decreasing, and certain measures are recommended by Mr Wilmot for their conservation. Regarding the herring industry, much is hoped for from the Report of the Special Commission, who investigated the cure and packing in this country and Holland,* and which has been circulated very widely. Opinions, especially regarding inspection, classification, and branding, were obtained from various Boards of Trade, Chambers of Commerce, &c., and were nearly all in favour of compulsory inspection of cure and quality, selection of herrings into grades, branding, &c. The principles of an Inspection Act are suggested as follows:—(1) That inspection of all herrings packed or imported shall be compulsory; (2) that at least three grades of fish should be established; (3) that a prescribed size and quality for the different packages be adopted, and that each package shall contain a required weight of fish, irrespective of salt or brine; (4) that all herring below grade No. 3 should be branded 'Culls'; also that the inspectors should be appointed by the Federal Government, and fees paid by the packer or importer. It may be said that if the history of the great herring fisheries in Europe teaches anything, it is the paramount importance of the proper selection, curing, and packing of the pickled herring.

Numerous recommendations have been made for the improvement of the lobster fishery—a fishery difficult to supervise from its remote and scattered operations. The following proposals have been made:—(1) A general close-time from 15th July to 1st January, both for fishing and canning; (2) special additional close-times for canning or curing on the Atlantic and Gulf coasts, divided into three regions for the purpose, the open time being in each case a little more than one month; (3) during the open season no restriction to be made as to the size of lobsters, canned or preserved; (4) possession, sale, or use of 'berried' females to be prohibited; (5) no lobster to be caught under 9 inches (with the exception stated above); (6) the artificial propagation of lobsters. Attention is also directed to the unsatisfactory condition of the oyster beds, and measures suggested for their improvement; and there are sections dealing with the Fisheries Protection Service, the Fishery Intelligence Bureau (for the collection and prompt dissemination of intelligence immediately useful to fishermen), on pound-nets, purse seines, &c. The Report by Lieutenant A. R. Gordon on the Fisheries Protection Service contains much interesting information and valuable recommendations, especially in the mackerel fishery, the lobster fishery, the bait question and fishery statistics, and a number of charts accompany the report. There is also a special report by Mr S. Wilmot, relative to the preservation of the white-fish fisheries of Lake Winnipeg.

In the Report by Mr S. Wilmot, the Superintendent of Fish Culture,

* *Vide Eighth Annual Report*, part iii. p. 364.

on the operations in fish-breeding, it is stated that 90,213,000 fish-fry, bred at the various hatcheries, were distributed in Canadian waters in the course of the year; making a grand total since the beginning of these operations in 1868 of 799,757,900 young fish. Of the output last year, 42,525,000 were white fish, 22,000,000 pickerel, and 9,861,000 Atlantic salmon (*Salmo salar*). Reports are given detailing the operations at each of the thirteen hatcheries. Mr Wilmot gives a very interesting report on the measures being taken in Canada in connection with the artificial propagation of the lobster. After visiting the hatchery in Newfoundland, he selected a site at Bay View, Pictou County, Northumberland Strait, Nova Scotia. The ground was purchased, and the erection of the hatchery begun, and the whole establishment was to be in readiness for work in May of the present year. The cost of the hatchery and appurtenances is estimated at 5000 dols., and the annual cost of upkeep at 1500 dols. The hatchery is in proximity to lobster-canning factories, and thus an abundance of lobster ova may be obtained. Mr Wilmot calculates that at eight factories in the neighbourhood 35,157 berried females are captured daily, carrying about 703,140,000 eggs. The number of ova consigned to the boiling vats of the canneries, in violation of the law, is said to be about 17,578,500,000 during the short season of two months at these eight factories alone. And since there are some 500 canning factories on the shores of the maritime provinces, at which the same method seems to be practised, it is clear the destruction of lobster ova is enormous. Mr Wilmot gives the results of an examination of a number of lobsters, with tables, with the view of determining the limit of size between mature and immature females; and recommends (1) the enforcement of close-time; (2) the prohibition of killing undersized lobsters; (3) the licensing of all lobster trappers and packers under certain conditions. Complaint is made of an invasion of packers from the United States, who can lobsters on the Canadian coasts, and put them on the markets under trade-marks which represent them to be of United States origin. The Report also contains a paper on the salmon fisheries of the Bay des Chaleurs, with plans of nets, fish ladders, &c.

## III. NEWFOUNDLAND.

By Adolf Nielsen, Superintendent of Fisheries.

Newfoundland possesses some of the finest fisheries in the world; its fauna is well adapted for resorts of vast quantities of food fishes, and its splendid, pure, and saline waters around the coast yield abundance of food for all kinds of marine fishes. The mainstay of the colony is the fisheries, in which 57,622 men are engaged out of the total population—193,124. The principal fisheries are the cod, the seal, the lobster, the herring, the salmon, and trout fishery, among which the cod fishery is by far the most important, and yields about three-parts of the entire returns of all the fisheries in value. This fishery is here divided into three distinct fisheries:—The shore, the bank, and the Labrador fishery. The shore fishery is prosecuted in the grand bays of Newfoundland and off the shore from boats (skiffs) with hook and line, jiggers, bultows, cod-nets, cod-seines, and cod-traps; the bank fishery mainly with bultows from vessels, after the American principle, on the great banks of Newfoundland; and the Labrador fishery on the coast of Labrador from Blank Sablon in the Straits of Belle Island, and as far north as Nain, latitude 56° 32′ 30″, with hook and line, cod-seines and cod-traps. A few Newfoundlanders also prosecute the cod, herring, and salmon fishery in

Canadian waters on the coast of Labrador. About one-fourth of the fishery products of the colony are taken from Labrador. The shore fishery is carried on from the month of May to the end of October, and in certain parts of Placentia Bay, until the end of December, and on the West Coast (district of Burqac and La Poile) quite an important winter fishery is carried on for cod-fish and halibut.

The bank fishery, in which 280 vessels of a tonnage of 15,212 tons, with a crew of 8719 men, were engaged last year, begins in April and ends in the month of October.

The Labrador fishery we may reckon to begin in the latter part of June, and it lasts until the latter part of September, or about three months.

The whole average value of the products of the cod fishery for the years 1888–90 will be as follows:—

| | |
|---|---|
| Export of codfish, 1,097,714 cwt., . . . . | $4,455,907 |
| " of cod oil, . . . . . . . . | 236,716 |
| Home consumption of codfish, 100,000 cwt., . | 400,000 |
| | $5,092,623 |

Second in importance is the seal fishery, in which 19 steamers of a tonnage of 5947 registered tons, about 20 sailing vessels, and 4284 men, were engaged in 1891. Each steamer carries a crew of from 200 to 300 men. In order to prevent the killing of the young seals at a too early date, or shortly after the whelping of the seals, the sailing of the steamers to the ice-fields is fixed for the 10th of March. The location of the seal fishery is in the Gulf of St Lawrence and off the north-east coast of Newfoundland.

The export value of the seal fishery in the three years 1888–90 has been as follows:—

| | Number of Seals Taken. | Value of Oil and Skins. |
|---|---|---|
| 1888 | 286,464 | $573,984 |
| 1889 | 335,627 | 675,381 |
| 1890 | 220,321 | 555,031 |
| Average for 3 years, | 280,804 | $601,465 |

Third in importance is the lobster fishery. In 1890 there was 162 lobster-canning establishments in operation, exclusive of those on the western coast, where the French have treaty rights, where some 60 to 70 factories have been operated in late years. The number of factories has up to this time increased considerably every year This fishery is prosecuted with traps; each factory runs from 200 to 1800 traps, which the proprietors furnish the fishermen with, and pay the men at a rate of from 70 to 120 cents per 100 for all the lobsters they catch.. In some of the northern bays the lobsters are also caught by spearing or hooking them up from the bottom in shallow water. The close season for these crustaceans has been from 5th of August to 5th of September, but as this fishery of late years has decreased very much on account of being pushed too vigorously, more stringent measures must be taken in order to preserve this industry from destruction in the future, and it is most likely that the

Legislature will sanction the recommendations of the Fisheries Commission this session, which go in the direction of having a close season from the 5th of August to the 1st of April, and regulating the traps so that all immature lobsters which get into the traps can get a chance to escape again from their prison.

The value of lobsters exported from Newfoundland in the years 1888–90 has been as follows:—

| | | |
|---|---|---|
| 1888, | 3,360,672 lbs., | $385,077 |
| 1889, | 3,658,368 „ | 472,524 |
| 1890, | 3,328,512 „ | 520,078 |

Fourth in importance comes the herring fishery. This fishery, which is yet but little developed, is prosecuted all around the coast of Newfoundland and Labrador with nets and seines, but never outside the coast with drift-nets, as in Scotland. The quality of the herring is good, and they are very plentiful in the bays, so there is no reason why this fishery should not equal the Scotch or the Norwegian herring fishery in value, if properly developed. A large quantity of herring is used for bait purposes by the Newfoundlanders, Americans, Canadians, and French; in fact, Newfoundland is the headquarter for bait-fishes; without access to bait in Newfoundland waters the above-mentioned nations cannot carry on their fishery on the great banks of Newfoundland successfully. About 70,000 barrels of herrings are salted annually, and about 35,000 barrels are exported in a frozen condition to Canada and the United States every winter.

Export and value of herring shipped from Newfoundland in the years 1888–90:—

| | Barrels. | Value. |
|---|---|---|
| 1888, | 89,225 | $253,658 |
| 1889, | 117,669 | 244,591 |
| 1890, | 94,421 | 241,218 |

To the foregoing must be added the export of herring direct from Labrador, which in the three years 1888–90 averaged per annum 15,676 barrels, average value 54,416 dollars.

Fifth in importance comes the salmon fishery. This fishery has been ruined by the people being allowed, until lately, to bar the rivers, thus preventing these noble fish getting up to their spawning grounds. There are many excellent salmon rivers in Newfoundland, but they are at present nearly all ruined. Rivers, which some 30 or 40 years ago yielded from 500 to 1000 tierces of salmon annually, do not at present give more than from 5 to 10 tierces. Trout is abundant in all the lakes and rivers in Newfoundland, and good sport can be had here in trout fishing. There is no trouble in getting from 12 to 15 dozen of trout in two or three hours' time.

Export and value of salmon from Newfoundland and Labrador in the years 1888–90 have been as follows:—

| | | |
|---|---|---|
| 1888, | 4678 tierces salted. | 275 cases tinned. |
| 1889, | 4089 „ | 314 „ |
| 1890, | 5561 „ | 781 „ |

Export value:—

| | |
|---|---|
| 1888, | $94,530 |
| 1889, | 83,356 |
| 1890, | 113,620 |

The total annual value of the fisheries of Newfoundland and Labrador, computed in the years 1888–90, has been as follow:—

| | |
|---|---|
| 1888, . . . . . . | $6,526,621 |
| 1889, . . . . . . | 6,371,304 |
| 1890, . . . . . . | 5,650,308 |

Average value per annum for three years, 1888–90, will thus be $6,182,744.

Detailed statement of the export value of the Newfoundland and Labrador fisheries in 1890:—

| | | | |
|---|---|---|---|
| **Cod Fishery.** | | | |
| Dry codfish, . . | 774,294 cwt. | $3,193,681 | |
| Green do., . . | 7,206 „ | 11,534 | |
| Boneless do., . . | 142,000 lbs. | 6,390 | |
| Cod oil, . . . | 3,195 tuns. | 242,820 | |
| Codliver oil, . . | 5440 gall. | 2,448 | |
| Cod blubber, . . | 8 tuns. | 80 | |
| Labrador codfish, . | 266,622 cwt. | 693,217 | |
| „ cod oil, . | 26 tuns. | 1,924 | |
| „ tongues and sounds, . | 1 barrel. | 6 | |
| | | | $4,152,096 |
| **Seal Fishery and Whale Fishery.** | | | |
| Seal skins, . . | 220,863 | $220,863 | |
| Seal oil, . . . | 3,719 tuns. | 334,710 | |
| Labrador seals, . . | 525 | 420 | |
| „ seal oil, . | 15 tuns. | 975 | |
| Whale bones, . . | 69 cwts. | 3,450 | |
| Whale oil, . . | 20½ tuns. | 1,630 | |
| | | | 562,048 |
| **Lobster Fishery.** | | | |
| Lobsters canned, | 69,344 cases. | ... | $520,078 |
| **Herring Fishery.** | | | |
| Salted herrings, . | 60,879 barrels. | $204,653 | |
| „ in bulk, . . | 1,842 „ | 1,842 | |
| Frozen herring, . | 37,700 „ | 34,700 | |
| Smoked and canned, | ... | 23 | |
| Herring oil, . . | 6½ tuns. | 325 | |
| Labrador pickled herring, . . . | 11,484 barrels. | 40,194 | |
| | | | 281,737 |
| **Salmon Fishery.** | | | |
| Pickled salmon, . | 4,639 tierces. | $93,084 | |
| Fresh „ . | 25 cases. | 250 | |
| Canned „ . | 756 „ | 3,024 | |
| Labrador salmon, pickled, | 822 tierces. | 17,262 | |
| „ „ frozen, | 38,080 lbs. | 3,808 | |
| | | | 117,428 |
| **Trout Fisheries.** | | | |
| Trout, pickled, . | 1,642 lbs. | $9,852 | |
| „ canned, . | 10 cases. | 50 | |
| Labrador trout, pickled, | 33 lbs. | 198 | |
| | | | 10,100 |
| Other fish:—Core-fish, turbot, ling, halibut, eels, bill-fish, caplin, fish skins, tongues, and sounds, . | | | 6,821 |
| Grand total, . . . . | | | $5,650,308 |

We have in Newfoundland a Fisheries Commission appointed by an Act of the Legislature, consisting of about sixty members, which has been in existence three years. The executive consists of seven members, chosen annually by the other members of the Commission. The work the Commission is charged with is to investigate the conditions of the various fisheries with a view to their protection and improvement; also to restore exhausted waters to their former abundance by artificial propagation, and to work for the improvement in the cure of edible fishes.

A hatchery for marine fishes is erected in Dildo, Trinity Bay, which has been in operation for three years; besides, floating incubators for hatching lobsters artificially are placed in every bay around the country. Last season 30 to 40 millions of codfish and over 551 millions of lobsters were hatched, and the fry planted in the sheltered fine bays of Newfoundland. A small hatchery for fresh-water fishes has been in operation for four years by a private society, at their own expense, in the vicinity of St John's, and has turned out annually about 100,000 fry of ova imported from foreign countries, in order to introduce foreign fish into Newfoundand waters.

In their Annual Report for last year * the Newfoundland Commissioners discuss a number of matters of interest. The improvement and development of the herring fishery have occupied largely the attention of the Commission. A number of barrels were cured and packed under the supervision of Mr Nielsen, and brought good prices in New York, Chicago, and Hamburg. At the latter place the herrings realised 7 dols. and 20 cents per barrel, and were highly approved; and it is stated that the prospects of establishing a trade with Europe in Newfoundland cured herrings are good. Mr Nielsen strongly condemns the practice of hauling herring during the spawning season, except for bait purposes; the seine-net is largely used. Rules for the curing and packing of herring were drawn up by Mr Nielsen, printed, and circulated. An expedition to discover, if possible, the summer resorts of the herring was made, with partial success. On the West Coast an extensive bank, 115 miles long, was found to be a resort of herring of good quality all through the summer.

At the hatchery for sea-fish at Dildo, large sea-water enclosures capable of containing 1000 spawning fish have been constructed. Last season 39,650,000 cod ova were hatched, and the fry planted. The number of adult fish being retained to form a stock of spawners with which to begin operations in the spring is 588. A new spawning pond, in which the fish will be allowed to spawn in the natural way, has been constructed; it is 47 feet long and 23 in breadth, and built of stone and Portland cement. The number of lobster eggs hatched and planted last year was 10,274,300 at the hatchery, and 541,195,580 in the floating incubators, making a grand total of 551,469,880. To produce this enormous output the ova from 28,369 lobsters were required, which otherwise would have been destroyed in the various canning factories—and the cost of output was only one cent for 2760 lobsters. Little doubt can be entertained of the great value and advantage to the fisheries of these operations. But in basing a calculation upon the probability of 10 per cent. reaching maturity, I think an error is involved. Ten per cent. becoming mature would represent 1500 or 2000 reaching maturity from the ova borne by one female.† Lobster culture and sea-fish, *e.g.*, cod, culture, have very

* *Annual Report of the Newfoundland Fisheries Commission for the Year* 1892, St John's, 1892.

† *Vide* my paper on Reproduction, &c., p. 190 of the present Report.

different relations. The female lobster carries her ova till they hatch, and is armed potently in their defence; and, I believe, so far as natural foes are concerned, defends them with great success. The eggs of fishes are cast forth, and are devoured in multitudes before they can hatch. Hence the benefit of the protection of the *ova* in the two cases is very different. But in Newfoundland the lobster eggs would be thrown away, and therefore the advantage of protecting and hatching them in such vast numbers must be enormous. In appendices Mr Nielsen gives interesting and detailed reports of his expedition in search of the summer herring, on the winter cod fishery at Channel, on the southern shore, and on the need of fishery statistics. The latter is brief, but to the point—and indeed, the collection of accurate statistics is a *sine qua non* in the judicious management of fisheries. Statistics are simply the quantitative expression or record of observed facts and relations; and the history of all fisheries shows that without it regulation has been much like a game of battledore and shuttlecock.

## IV. NEW SOUTH WALES.

The Report of the Commissioners of Fisheries for 1890 was issued last year. It is pointed out that there has been a falling off in the number of applications for leases for oyster culture, and neglect of lessees to pay up arrears of rent due upon their holdings. During the year the sum of £1160, 8s. 4d. was paid as rewards for the destruction of cormorants and 'shags,' which are very destructive to the fisheries. These birds exist in vast numbers on the Murray River. The Commissioners recommend that this regulation should be repealed. They state that the blacks and half-castes raid the nests at the breeding season and capture the fledglings, and as each nest contains an average of three birds, a large number could be without difficulty collected. That seems on the thesis quite legitimate; but they also say:—'Another plan pursued was 'to collect the eggs and hatch them out under a hen, or in an incubator. 'A few half-castes made this quite a business, so that the greater part of 'the large sum paid as rewards for capture passed to those persons.' In the operations on fish acclimatisation, the endeavours to introduce trout were repeated; 5000 ova of *Salmo fario*, 1000 of *Salmo levenensis*, and 1000 fry of *Salmo fontinalis* were obtained, and a large percentage of the ova hatched and distributed. From experiments it was found that trout fry could exist in hermetically sealed jars for seventy-two hours at least; and fry thus treated were successfully transported to New Zealand. Details are given as to the distribution; these operations would have a much greater chance of being useful if they were conducted on a greatly increased scale.

In regard to oysters, the Commissioners are unable to report that the industry is in anything like a flourishing condition, the returns comparing most unfavourably with those for the previous year, and 'comparison with 'previous years is still less encouraging.' New South Wales is indebted to other colonies—New Zealand and Queensland—for two-thirds of its supply. The causes of the failure in the native supply are attributed partly to floods and the ravages of the 'worm disease;' but 'the main 'reason is that many of those who during past years have taken up fore-'shore for oyster culture have not practised culture at all'—they seem to have been desirous to collect and sell at once all the oysters that they could gather. An increase took place in the fisheries generally, to the extent of 2486 baskets and £4383. The Commissioners give the draft

of a very elaborate Fisheries Bill, repealing all existing legislation, reserving to the Commission larger and more effective powers of regulation, and providing for the artificial propagation of fish and oysters. This Bill is drawn strictly upon the principle of interference and restriction. It provides for the lengths and dimensions of nets, the size of mesh, &c., for various fisheries in inland waters; and legal modes of fishing are in several cases rigorously defined. Immature fish are to be prohibited—not according to a standard of length, as in some countries in Europe, but according to a standard of weight, and a schedule is appended giving the weights for 28 species, and which vary from 2 oz. to 4 lb. Lobsters and salt-water crayfish have not to be sold under 4 inches in length, and fresh-water crayfish under 3 inches. Fishermen in tidal or inland waters have to take out licenses for themselves and boats, and such waters may be closed for periods against line or net-fishing. It is provided that Crown lands below high-water mark may be leased for fishery purposes, and especially for oyster culture. A number of statistical tables accompany the report.

## V. UNITED STATES.

In the Report of the United States Fish Commission for 1887* is contained a fund of information in regard to the fisheries of the States, and the operations of the Fish Commission in their furtherance. This Report covers the work done during the fiscal year, that is, for the eighteen months between January 1, 1887, and June 30, 1888, in order to include an account of the operations in fish-culture during the winter 1887–88. Colonel Marshall M'Donald, previously Assistant Commissioner, was appointed Commissioner in January 1888, and in the present Report an interesting review of the development of the Commission, since its establishment in 1871, is given. The labours of the Commission are too well-known to require recapitulation here, but it may be said they have fallen into four divisions—administration, scientific inquiry, fisheries, and fish-culture. In April 1888, a Bill was introduced into the House of Representatives providing for the reorganisation of the Commission of Fish and Fisheries, and defining its duties. Although this Bill did not become law, it is stated that the organisation proposed has been adopted, and, as given in the Bill, may be briefly summarised as follows:—(1) Continuation of scientific investigations on a broad and comprehensive plan into all matters connected with fish-life; (2) continuation of the investigation into the history of the methods and apparatus of the fisheries, and for the preservation and utilisation of fishery products, the study of new methods and apparatus, and the furnishing of information upon which to frame intelligent legislation regulating the conduct of the fisheries and improving their methods and apparatus; (3) to provide for the collection of fishery statistics, especially those of international importance, which may become the subject of treaty stipulations; (4) continuation of fish-culture. The new duty of collecting statistics cannot fail to be of very great service. The United States, so progressive in all that pertains to fishery inquiry and fish-culture, and, indeed, the pioneer in these departments, is at present almost the only great fishery State which does not collect systematic statistics annually relating to its fisheries.

In the division of fish-culture, it is stated that the total production for the fiscal year 1887–88 of the 13 stations and the steamer 'Fish Hawk'

* *United States Commission of Fish and Fisheries*, part xv., Report of the Commissioner for 1887, Washington, 1891.

was as follows:—74,326,849 ova, 164,607,054 fry, 48,056 one-year olds, and 4158 more than one year old. The greater number consisted of shad and white-fish (*Coregonus*). At Wood's Holl Station, 7,822,000 cod fry were hatched, 2,092,000 lobster eggs, and 320,000 of the winter flounder (*Pseudopleuronectes americanus*). The ova of the latter are extremely adhesive, and have a tendency to form in large lumps. They were hatched by spreading them thinly on plates of glass. Of the lobster ova, 193,000 were sent to the Pacific coast, where the inhabitants have long desired to add the lobster to the food-supply of their seas, and have from time to time urged the Government to attempt its transfer. Experiments were begun in 1873, but failed; the second shipment, in the following year, resulted in the planting of only four lobsters of 150 forwarded; but in 1879 twenty-one berried females were successfully planted. The fourth trial was made in 1888, and resulted in the transport of 332 lobsters, which were placed in the sea, or in floating boxes, and also some 200,000 ova. The experiments in introducing the shad on the Pacific coast are of interest. Between 1871 and 1880 about 546,000 shad fry were planted in the Sacramento River, and from these colonies the shad have multiplied and spread along 2000 miles of coast, from the Golden Gate of California to Vancouver Island in British Columbia.

The exploring expedition of the steamer 'Albatross,' belonging to the Commission, on the Pacific Coast is described; also the work of the 'Grampus' and other vessels. The 'Grampus' was specially employed in connection with investigations on the mackerel fishery. Over 250,000 floating fish eggs, taken in the surface-nets, were carried to Wood's Holl and hatched, the embryos being preserved for identification. It is stated that should these eggs prove to belong to useful species, it will probably be expedient to make a practice of collecting and hatching them on a large scale. There is a long and elaborate report on the fisheries of the Great Lakes, with many illustrations and charts, showing the fishing vessels, fish, fishing apparatus, &c. Dr Jordan contributes a review of the Labroid fishes of America and Europe, in which he gives a systematic catalogue and synonymy; Professor Forbes describes some Lake Superior Entomostraca, which has special importance in relation to the food of fishes. There are also notes on the Entozoa of marine fishes of New England by Professor Edwin Linton.

## VI. GERMANY.

In last year's Report a full account was given of what has recently been done in connection with the sea fisheries of Germany; and there is further evidence of the strenuous endeavours being made by this nation to establish itself in the North Sea. A Biological Station has been established at Heligoland, for the special purpose of carrying on scientific fishery investigations bearing upon the North Sea Fisheries. Dr Heincke is the director of this institution, and he has Dr Ehrenbaum and Dr Hartlaüb as assistants. The Zoological Station belonging to the fishery department was stationed last year on the Elbe, where Dr Ehrenbaum was engaged in investigations on the Elbe fishes. Dr Heincke is, I understand, preparing a great work on the races of the herring, in continuation of his well-known investigations on this subject.

Dr Ehrenbaum recently published a paper on the anchovy,* in which he gives an account of the German anchovy fishery, and discusses the

* *Die Sardelle*, Berlin, 1892.

conclusions of other observers, especially those of Dr Hoffmann, regarding the anchovy in the Zuider Zee.

## VII. SWEDEN.

In his Report on the sea fisheries of Gothenburg and Bohusland, Dr A. H. Malm, the Inspector of Fisheries, gives various particulars of interest.* The total value of these fisheries, from 1st April 1890 to 1st April 1891, was 3,576,432 kröners—an increase of 823,252 kröners over the previous year. The value of the deep-sea fishery (*Storsjöfisket*) was 497,374 kröners; of the mackerel fishery, 470,191; of the herring fishery, 2,161,393—an increase of 767,557 kröners; of salmon, 17,117; of lobsters, 104,564; of oysters, 10,737. Both of the latter show a considerable decrease. Of a total of 283,752 barrels of herrings, 161,110 were cured and packed after the Scotch fashion, and 118,866 after the Norwegian; 3776 were treated as 'split fish.' The price obtained at Stettin for 'fulls' in January, February, and March was 20 to 22 marks, and for 'medium fulls' 16 to 18 marks.

As pointed out in last year's Report (Part iii. p. 408), great efforts are being made to imitate the Scotch system of curing and packing of herrings. A sum of 2500 kröners has been set aside by the Economic Society in order to obtain the services of Scotch coopers (*Skotske salteri-förmän*) for instruction in the mode of herring curing and packing in Scotland. A new mode of preparing small herring has been tried, which may merit attention in Scotland, that is as split fish (*Klippt sill*). The head and the edges of the belly are cut off, and the guts removed, and the herrings are packed close and tightly together, with as much salt as will preserve them for a year. The length of such split fish ranges from 16 to 18 centimetres, and they are sent to Austria, where they undergo further treatment, to form an article called 'Russian Sardines.' The curers get about 10 kröners a barrel for such split herrings. A table is given of the exports of herrings, from which it appears that very large quantities come to England. From Gothenburg alone 4,757,420 kilos were exported to England (Hull, Newcastle, London, and West Hartlepool). From Marstrand and Instön 20,710,300 kilos were sent to Germany and England; from Lysekil 10,992,400 kilos were exported to England, Germany, Denmark, and Norway; from Strömstad 12,128,872 kilos were despatched to England, Fredrickshaven, and Norway, and large quantities from other places. These figures serve to explain the depression in the prices of Scotch herrings in the English markets. The oil and guano factories used 55,000 hectolitres of herrings.

The number of vessels engaged in the deep-sea fishing was 156, of 3280 tons, and manned with crews numbering 1354 men. In the Bohuslän herring fishing 134 boats, manned by 667 men, used drift-nets in the autumn, the value of the herrings caught being 102,167 kröners. The number of boats using set-nets was 1040, manned by 3236 men, the value of the herrings caught being 887,183 kröners. The number of scine-nets (*vadar*) used was 203, employed by 2074 men, the value of the catch being 1,172,043 kröners. In the lobster fishery 1906 men employed 34,024 creels, and caught 209,580 lobsters, valued at 104,564 kröners. The yield of oysters was 72,400, valued at 10,737 kröners.

Last year a Swedish Fishery Conference was held at Gothenburg which was attended also by representatives from Norway, Denmark, Fin-

* *Berättelse öfver Göteborgs och Bohus läns hafsfisken under*, 1890–91. *Göteborg*, 1891.

land, and France.* At this conference a number of important practical and scientific questions were considered. Dr C. G. J. Petersen, of the Danish fishery department, contributed a paper on his 'Studies on the 'Age and Growth of Fish, with some allied questions' (*vide* p. 349), and Dr L. Kolmodin gave the results of observations as to the most suitable depth to which herring drift-nets should be sunk under different circumstances. He pointed out the importance of the temperature and the presence of pelagic food (*Cladocera*, Copepoda), and explained a new apparatus he had devised to determine the food and temperature. Fishermen recognise as important the relations of current, wind, and light. With south and south-west winds the nets are usually set at a greater depth than when the wind is east or north, and this is due to a change in the temperature of the water. Dr Kolmodin's apparatus has been used since 1887 at seven of the ten stations formed in Gothland for fishery observations, and the author states that the boats employing his apparatus have, on the whole, obtained better catches than the boats fishing without it.

Fishery Inspector Landmark described the mode of marking salmon and sea-trout now used in Norway, and which consists in clamping a small silver plate to the posterior portion of the dorsal fin. Each plate is 10 mm. long by 4 mm. broad, and has a number stamped on it. Each end consists of a claw at right angles to the plate; these are thrust through the fin, and the ends bent towards one another. Some interesting results as to rate of growth, frequency of spawning, &c., are given. Very few marked male salmon were recaptured. A discussion took place on this question:—'Has experience shown that herring curing according to the Scotch method offers better results than the Norwegian method; and, if so, is the establishment of the Scotch system of selection and branding desirable?' No definite conclusion was reached; an objection to a system of branding was stated to be the periodical character of the Bohuslän herring fishery, especially when considered in connection with the greater cost of the Scotch system.

Dr Heincke, whose important investigations on the herring are so well known, read a suggestive paper on the desirability of international co-operation in obtaining a more complete knowledge of the migrations of the herring. He proposed that a number of stations in the North Sea and Baltic should be selected in relation to the coasts of Norway, Sweden, Denmark, Germany, Holland, and possibly Finland, and then in England and Scotland. At each station collections of herrings of all ages should be made, with records of the spawning places, and specimens of the spawn; and twice a month, during the herring fishing, fifty herrings should be taken without selection from the greatest catches, and records made of the sex, condition of the reproductive organs, contents of stomach, and amount of fatness. A certain number should be set apart for investigation of the relations of body structure, according to Dr Heincke's method. Dr Heincke suggests that the directors of the central station in each country should form an international scientific herring commission for the study and elaboration of the results.

In connection with the question of immature fish, the following was discussed:—'How far, with regard to the preservation of the fish supply, there ought to be established in the interests of the fish trade and of consumers, general sizes for saleable fish; and whether it is desirable and practicable to make international regulations thereupon.' The London International Conference of 1890 was referred to, and quotations made from the addresses of Professor M'Intosh and others, and it was stated

* *Förhandlingar vid första allmänna Svenska Fiskerikonferensen i Göteborg*, 1891. Stockholm, 1892.

that the work done in Scotland on the subject was the most important and instructive. The general sense of the discussion pointed to the desirability of regulations being made in each country first, and that subsequently international regulations might be arranged, especially in those countries which possessed common boundaries.

Many other interesting and important questions were discussed.

The *Bohuslän Fishery Journal*, which is edited by Dr Axel Vilh. Ljungman, contains many interesting papers on fishery questions.* The regulations of the Fishery Board for Scotland anent the new brands are translated in full—as has also been done in Norway and Holland. Another paper gives very full details, with illustrations, of the Scottish system of selection, gutting, curing, &c. of herrings (*Jakttagelser vid sill-saltning efter skotsk metod*); and Ljungman gives a description of the herring curing and fishing in various countries. Among other papers are some on the preparation of Russian sardines, the curing of mackerel for America, the improvement of Bohuslän fisheries, &c.

## VIII. NORWAY.

The sea-fish hatchery at Flödevig, Arendal, continues in active operation, under the direction of Captain G. M. Dannevig. During the last hatching season (1892) 605 litres of cod spawn were dealt with in the hatchery, of which 462 litres were hatched, the loss being under 24 per cent., as compared with 30 per cent. last year. Over 207,000,000 young cod were hatched and planted on the fishing grounds.

Captain Dannevig has published a paper, giving a description, illustrated with plans, of the new hatchery, showing the enlargements and improvements.

From the official statistical report on the Norwegian fisheries† it appears that in 1890 the gross value of the Norwegian fisheries—including those for whales, seals, &c.—was over 25,650,000 kröners. The coast fisheries—including those for herring, cod, mackerel, &c.—were valued at 22,212,000 kröners, compared with 23,311,000 in 1889. The cod fishing is the most important, and yielded 63,303,250 cod, 194,914 hectolitres of liver, and 63,355 hectolitres of roe. The cod were valued at 11,764,759 kröners, the livers at 1,674,797 kröners, the roes at 457,165 kröners, and the cod-heads at 178,048 kröners—giving a total value of 14,074,769 kröners. The quantity of herrings caught amounted to 808,000 hectolitres, valued at 3,879,439 kröners. The summer and autumn fish (*fedsild*) brought 2,973,000 kröners, and the winter and spring herring 907,000 kröners. Sprats and small herrings were valued at 261,000 kröners; mackerel at 512,000 kröners; salmon and sea-trout at 656,000; lobsters at 366,000; oysters at 14,032. It is worth while giving the figures referring to the lobster fishery; they are as follows:—

| Year. | Number Caught. | Value. Kr. | Average Price per Hundred. |
|---|---|---|---|
| 1886 | 1,134,000 | 428,000 | 37·75 |
| 1887 | 889,000 | 395,000 | 44·48 |
| 1888 | 855,000 | 414,000 | 48·42 |
| 1889 | 795,000 | 402,000 | 50·62 |
| 1890 | 627,000 | 366,000 | 58·39 |

* *Bohuslänsk Fiskeritidskrift, Jan.-Dec.* 1890. Göteborg, 1891.

† *Tabeller vedkommende Norges Fiskerier i aaret* 1890, *samt Beretninger angaaende deres drift. M.V. Kristiania,* 1891.

Two things are clear from this table, namely, the gradual decrease in the number of lobsters caught, and the gradual advance in the average price.

In the cod fishing, 89,283 men and 21,356 boats were employed; in the herring fishery, 29,804 men and 6444 boats; and in the mackerel fishery, 3335 men and 880 boats. The value of the fish and fish produce exported was 48,489,600 kröners, compared with 45,584,600 kröners in 1889. The cod exported were valued at 24,487,900 kröners, besides 6,811,800 kröners for cod oil, and 1,052,500 for roe. The value of the herrings exported was 11,030,700 kröners.

A special report is published on the famous Loffoden fisheries.* It contains very complete details on all points connected with the fishery—the administration, regulations, numbers of men and boats, the catch of fish, fatalities, weather and temperature observations, &c.

A number of interesting papers are contained in the Norwegian Fishery Journal.† There is an excellent historical and statistical account of the Norwegian mackerel fishery, of line fishing in olden times, &c. The law passed in 1891 restricts the use of seine-nets for the capture of cod at certain parts of the coast, prohibiting certain kinds, and regulating the use of other kinds. Power is given to the King, on the representation of the provincial councils, to extend these regulations to other districts. From a paper on the exports of Norwegian fish, it appears that dried cod is chiefly sent to Italy, Sweden, Germany, and Holland, and split cod (*Klipfisk*) to Spain, Italy, Germany, and the United Kingdom. Of 55,577,000 kilogrammes exported, Spain received no less than 35,273,000 kilogrammes, Germany taking 6,688,000 kilogrammes, and the United Kingdom 4,791,000 kilogrammes. Of 660,000 lobsters exported, 204,600 came to this country, and 361,500 were sent to Denmark. The United Kingdom also imported 1,807,000 kilogrammes of fish guano, 496,900 kilogrammes of salmon, 1,046,100 kilogrammes of mackerel, and 5,673,800 kilogrammes of herring. By far the greater part of the exports of mackerel and herring from Norway come to this country. From one of a valuable series of reports supplied by Norwegian Consuls in various countries, it appears that the imports of split cod for the north of Spain (*viâ* Corunna, Bilbao, Santander, &c.) in 1890 were:—Norwegian, 16,204,865 kilogrammes; French, 4,020,850 kilogrammes; Icelandic, 1,781,900 kilogrammes; and Scotch, 689,753 kilogrammes. In 1881 the imports of Scotch cured cod formed 6·51 of the total; last year it formed 3·04 per cent.

## IX. DENMARK.

The Report of Captain C. F. Drechsel, the Superintendent of Danish Fisheries, contains a great deal of valuable statistics and information relating to the fisheries of Denmark for the year 1890–91.‡ Under the Danish Fishery Law, referred to in previous Reports, regulations have been made for a certain part of the coast (Stavns Fjord), as follows:—(1) Seine fishing is prohibited from 1st April to 30th June, except for bait; (2) eels under 14 inches, and cod under 9 inches, are not to be landed, except in certain cases for bait; (3) certain tackle for eels are

* *Lofotfiskeriet*, 1890. *Beretning afgiven af Opsynschefen, C. Knap, Kristiania*, 1891.

† *Norsk Fiskeritidende, Udgivet af Selskabet for de norske Fiskeriers Fremme*, 1891.

‡ *Fiskeri-Beretning for Finantsaaret*, 1890–91, *af C. F. Drechsel, Kapitain i Fladden, Kjøbenhavn*, 1891.

prohibited, and spearing interdicted between 1st November and 1st April. Probably in no country are the fishery regulations more complete and thorough than in Denmark, and the results will be watched with much interest. The fishery statistics deal with the fisheries inside the Skaw, those in the Limfjord, and those in the North Sea. The value of the Danish fisheries within the Skaw was 3,728,110 kröners, as follows (in kröners):—Cod, 403,844; flounders (chiefly plaice), 1,157,277; soles, 201,694; turbot, 13,385; brill, 18,212; mackerel, 44,680; herring, 747,550 (in seines, 263,003; in drift-nets, 484,547); eels, 662,640; salmon and eels, 161,566; shrimps, 140,118. The lumpsucker (*Cyclopterus*) is becoming more generally used; the value of this fishery was 9533 kröners in 1890. The number of men employed in these fisheries was 7615. In what is termed the great fishery in the Kattegatt, 202 cutters, 133 boats, and 1362 men were employed, the value of the fish caught being 1,184,343 kröners, or an average of 870 kröners per man. Full statistics are given for the fisheries in the Limfjord. The Danish fishing fleet in the North Sea and Skagerrak consisted in 1890 of 487 vessels, with a total tonnage of 4529; but it appears that statistics of the fish caught are not available. The Government has granted a considerable sum for loans to fishermen; a new insurance system for fishing boats has been established, and a law made permitting fishermen to go to sea as 'skipper' without a certificate. Five cutters left this spring for Iceland to fish for halibut, and a biologist accompanies one of them, in order to study the fisheries in Iceland.

The results of several important fishery investigations are given. The gunboat 'Hauchs' made observations as to the abundance of the Baltic form of turbot (*Botten*) on the coasts of Bornholm, and the possibility of establishing a trawl-net fishery for them. This fish is caught with set nets, but it is much smaller than the turbot of the North Sea or Kattegat. Specimens of 5 or 6 lbs. weight are very rare, the average weight being about 1 lb. The inquiry showed that the nature of the bottom was not fitted for trawl-fishing. An investigation was also made into the marine bottom and surface fauna along the west coast of Jutland.*

In connection with a grant of 25,000 kröners for fishery purposes, the necessity is pointed out of endeavouring to discover new grounds for the prosecution of Danish fisheries, since the fisheries in the Kattegat and North Sea are diminishing every year, whilst at the same time the number and size of the vessels are increasing (p. 222). In 1885 there were only 32 decked vessels fishing for flat-fish in the Kattegat, but at the end of the year 1890–91 the number was 202. In 1885 the largest cutters were about 40 tons, while they are now built of 70 tons and more. The use of steam-capstans for the seine-nets has made it possible to carry on the fishery in the Kattegat with greater energy than before. It is also pointed out that while previously Germany formed the best market for Danish fish, the Germans are now in a position to supply themselves with flat-fish; and that, from the Weser alone, thirty steamers go to fish in the North Sea.

A long account is given of the London International Conference of 1890. Dr C. G. Joh. Petersen gives the results of the investigations made in connection with the Danish Biological Station, dealing chiefly with the biological relations of the fish in the Holbaek Fjord. Probably the most important is his work on the spawning time, rate of growth, maturity, food, &c., of a large number of fishes; but it is impossible to

* The gunboat 'Hauch' has continued the exploration of the grounds within the Skaw, and an elaborate report has been published relating to the hydrography, and a special account also given of the Polyzoa.

summarise it here. Dr Petersen groups the fish studied according to whether their eggs float or not, and deals with the following:—*Zoarces*, *Syngnathus*, *Nerophis*, *Gobius*, *Gasterosteus*, *Spinachia*, *Cottus*, *Cyclopterus*, *Clupea harengus*, *Belone*, *Ammodytes*, *Ctenolabrus*, *Pleuronectes flesus*, *P. platessa*, *Rhombus maximus*, *Solea vulgaris*, *Anguilla vulgaris*, &c. Tables are given showing the measurements of males and females of the different species. Holbaek Fjord is much smaller than the Firth of Forth, and Dr Petersen's general results agree with those obtained in the latter area. He refers to the seaward movement of fish with pelagic ova, and also of the herring, at the reproductive period. He has never found a single floating egg within the Fjord, but only further out and in the Kattegat; and he looks upon it not as a breeding place but as a nursery.

## X. HOLLAND.

The Official Report on Dutch fisheries contains as usual a great mass of information concerning them.* In 1890 the catch of herrings by the luggers and sloops was somewhat less than in 1889, but the average price was higher. In 1889 the catch was 17,939 lasts, compared with 17,615 lasts in 1890; but the value rose from 2,600,000 Dutch guilders in 1889 to 2,900,000 guilders in 1890. The total catch of the herring fleet was about 474,000 barrels of salted herrings, and about 46,000,000 fresh herrings; and thus the herring harvest of the Dutch in the North Sea amounted in 1890 to about 391,000,000 fish. Although salt and barrels were dearer than in the previous year, the results to the merchants were very satisfactory. The export of Dutch cured herrings decreased from 310,740 barrels in 1889 to 283,092 in 1890—the decrease being chiefly connected with the export to North Germany—which fell from 78,774 barrels in 1889 to 24,540 barrels in 1890. The number of vessels taking part in the great or salt herring fishery was 196, compared with 194 in the previous year, and these consisted almost entirely of luggers and cutters. Including the fishing-boats (*Bomschuiten*), the herring fleet numbered 462. It is noted that an attempt was made to open up the herring fishing to the west of the Shetland Islands, and with success. It had been stated that it was impossible to fish successfully in that region, owing to the strength and inequality of the currents. Each of the two vessels that tried it brought back 26 barrels of salted cod, 58 barrels of coal-fish, and 17 lasts of herrings. Of the 17,615 lasts of herrings caught 13,542 lasts consisted of 'full' herrings (*volle*), and only 928 of maties. Very full tables are given relating to the catch and cure of herrings. In the Zuider Zee the anchovy fishing was exceptionally successful, 190,000 ankers, representing about 600,000,000 fish, being caught. The oyster industry was not successful in 1890, a fact partly attributed to the low and variable temperature in the beginning of summer destroying the brood. In the course of the summer about one-third of the full-grown oysters died, and in the winter the long frost proved very destructive. 'The year 1890,' the Report states, 'will long remain a sad memory to our oyster breeders.' The new branding regulations of the Scotch Board, and also the Report of Mr James Johnston and Mr W. Anderson Smith are translated in full.

In the investigation being made by Dr P. P. C. Hoek, the scientific fishery adviser to the Government, on the scarcity of fish on the Dutch coasts, it is stated that the absence of proper statistics has been a great

* *Verslag van den Staat der Nederlandsche Zeevisscherijen over* 1890.

drawback, and that actual fishing operations should be carried on by a steam-vessel, as is done on board the 'Garland.'

We have received the Report of the Fifth Annual Conference of the Society for the Promotion of Dutch Fisheries, which was held at Scheveningen in May last year.* A number of fishery matters were discussed. The propriety of regulations, with the view of preventing the destruction of immature fish, and of such regulations being made international, was debated. It was pointed out that in conformity with the resolution proposed by Dr Hoek at the London Conference, investigations were being made into the causes of the falling-off in the supply of flat-fish in the North Sea, and no agreement was come to on the question; but it was proposed and carried that the mesh of the nets used for plaice fishing should be not less than 9 centimetres from December to 1st April, and during the rest of the year not less than 6 centimetres.

In a Special Report Mr C. J. Bottemanne, the Superintendent, gives an account of the fisheries in the Schelde and Zeeuwsche rivers in 1890.† These fisheries are varied and valuable, comprising flat-fish, herrings, eels, anchovies, smelts, oysters, mussels, shrimps, &c. The catch of shrimps was about 1,500,000 kilos.; oysters yielded 4,420,158 kilos.; and mussels 884,584 kilos.

Dr P. P. C. Hoek has published in English a translation of a chapter of a Report submitted to the Dutch Board of Fisheries in 1889, dealing with the fishes of the Zuider Zee.‡ It treats of twenty-four species of fish, and especially of immature flat-fish and their differential diagnosis, and of the smelt and herring. A chart of the Zuider Zee, and figures of various larval fishes, are given.

## XI. SPAIN.

By Mr W. Anderson Smith.

One of the most important papers in the *Revista de Pesca Maritima* for 1891 is that on 'The Regulation of Fisheries,' by Dr Juan Vilaró Diaz, of the Fishery Commission of Havana. He discusses the proposed Act of 13th July 1890,§ having reference to 'the shellfish and 'crustaceans of the litoral of the *Apostadera* which are of value for food 'or industrial purposes, and consequently deserve to have a close time 'established for their fishery, that their production may be protected.' He discusses the meaning of the unscientific terms employed, and wonders whether they can be made to include marine turtles. He remarks that besides their own univalves employed as food (*Cobos*, *Siguas*, &c.), they import from Spain and the Canaries a quantity of live *Caracoles*—*Helix lactea*, Müller, vulgarly *Caracot moro*—for culinary use. It is distinguished by its black mouth from the *Caracol* de Monte or Serrano—*H. alonensis*, according to Pérez Arcas—which is whitish, barred with black. It is also imported for consumption by 'Peninsulars.' He acknowledges the difficulty of dealing with such species as the Lobster (Langosta), which carries eggs during ten months of the year, and when it is in best condition. He holds:—1st, That the period of reproduction

* *Verslag van de Vijfde Jaarlijksche Algemeene Vergadering van de Vereeniging ter bevordering van de Nederlandsche Visscherij*, 1891.

† *Verslag omtrent den toestand der Visscherijen in de Schelde en Zeeuwsche Stroomen in* 1890. Tholen, 1891.

‡ *Overgedrukt uit het Tijdschrift der Nederlandsche Dierkundige Vereeniging* (2) *iii. Afl* 1, 1890.

§ Since withdrawn.

includes from September to January. 2nd, That it takes twenty days, more or less, for the deposition of the eggs from the incubating purse of the female. 3rd, That the incubation lasts six months, during which the eggs remain fixed by means of a glandular secretion. 4th, That the birth of the larvæ—or Zoæ—takes place in spring, from March to May. He elsewhere speaks of the *Homarus*, called French lobster at Corunna, and elsewhere Bogavante, Logavante, &c., which steadily diminishes, *because the young are sedentary and consequently more easily destroyed.*

He calls attention emphatically to the uselessness of promulgating laws unless they are carried out and means supplied for doing so. [Another paper says, 'like the foolish virgins we have lamps but no oil.'] And further, that unless local authorities support the efforts of the higher authorities, destruction is winked at, not checked. Then follows a list of species, defined by their vulgar and scientific names, and their Spanish congeners, with the close time and the minimum size.

In an interesting letter from Havana, Juan Vilaró writes of the wealth of those seas, that every year they destroy by fire great quantities of Mullet (*Mugil Lebranchus*) owing to insufficient salt to cure the millions taken. He resents this :—'Seeing that we are the greatest consumers of 'salt provisions in the world, Spain and Cuba having consumed in seven 'years—1870 to 1876—179,201,950 kilos of fish, which cost our country '22,682,715 dollars; considering the elements that ought, as they might, 'stimulate our endeavour and conquer our indolence, namely, our enviable 'geographical position; vast production, easy to keep and increase; suit- 'able and secure markets; great demand, with certain increase if cheapened; 'and, as a natural sequel to all this, no fear of competition, it being so 'easy for us to form boundless everlasting saltpans in our warm and 'intricate bays, where from the month of June it reaches 32° C. in the 'shade, a figure that speaks for itself. We are so greatly favoured by 'the providential Gulf Stream, which closes the road to the north to one 'portion of our edible species, as our savoury Cherma criolla (*Epinephelus* '*striatus*), that grows to 12½ kilos, as well as the Pargos (Pargo criollo, '*Lutjanus analis*; Pargo guachinango, *L. campechianus*; Pargo de lo alto, '*L. profundus*), greatly increased by the Guasa (Promicrops Guasa) that 'runs from 50 to 300 kilos of meat, as fine in a fresh state as unequalled 'salted, it is natural that I complain, on every possible occasion, to see 'how our rich fisheries are neglected, when they are not wasted.' Vilaró Diaz concludes his valuable monograph on Havana fisheries by the following conclusions, which he proposes to the Commission :—

1st, That a close time ought to be instituted for the fishing of Molluscs, Crustaceans, and useful Turtles. 2nd, The close time for *Pholas*, *Lithodomus*, *Solen et varius*, under the generic name of Almejas, Coquina, *Venus*, *Cardium*, *Pecten*, and *Modiola*, should include from 1st January to 30th June. 3rd, The close time for Oysters should extend from 1st May to 30th September (not August as with us). 4th, The close time for *Squilla*, Palæmonidæ, *Scyllarus*, *Palinurus* of species, *Mithrax*, *Menippe*, *Lupa* of species, and *Cardisoma*, should last from 1st October to 31st March. 5th, The close time for Turtles (Carey, la Caguama, and la Tortuga) ought to last from 1st May to 30th August. 6th, The distribution and sale of mussels (*Mytilus*), the Ajae terrestre (*Gecarcinus*) and Ajae de Momglar (*Uca*) ought to be prohibited, as being dangerous or injurious for food.

This covers a very wide area, and the proposed minimum size is given with most of the species, which list shows a general use of many genera never employed as food in this country. Attention is called to the law of 31st July 1891, by which the Portuguese Government will only permit trawling to those vessels already registered, and those only for ten

years, at the end of which time this class of fishing (by one or more vessels) is to cease in the territorial zone of Portugal, *because it is injurious and ought to be suppressed.* The reports on which this decision is founded are given in full.

The regulation is supported on three special grounds :—

1. That in the territorial waters the State has power to legislate as well for natives as for foreigners.
2. That in the outer free waters they have the right to regulate the native vessels.
3. That in these outer free waters, within certain limits and restrictions, they cannot impose rules on foreign vessels, *but they can demand commercial import duties in the national waters and ports* (the italics are ours).

The whole weight of evidence adduced is against trawling, as an injurious mode of fishing.

Señor Hidalgo Bermúdez proposes to employ oysters and the coral insect to create natural harbours around Spain. When the translator proposed to employ the *Modiola* for this purpose, in his prize essay, London 1883, it was only as a binder for loose material; but the Spanish inventor looks to the oyster-bed to increase so rapidly as to form a breakwater of itself. His figures are delusive; and although at the mouth of the Gironde, the Portuguese oyster increased so fast as to obstruct navigation, this is quite exceptional conduct. As a binder, however, it will no doubt prove of value.

D. Joaquin de Borja, in his memoir presented to the Minister of Marine, along with a Zoological Collection prepared by him at Naples, summarises his views with much force and ability. . . . . . 'As to 'the sedentary species, such as flat fish, *Scorpæna*, &c., that live at great 'depths, the minimum size at which they ought to be authorised to be 'sold in the markets ought to be decided. And in place of establishing 'useless close times, and still more useless sizes in the meshes of the nets, 'municipal authorities ought to exercise vigilance in the markets, so that 'only those that have reached a certain development be sold; since it is 'self-evident that, if the fishermen can only sell fish of a certain size, they 'will henceforward take every care not to catch them. And if, in con'sequence of the lack of vigilance, the coast becomes impoverished of 'certain species, the fault will be that of the public administration and 'not of the fishermen, since these must engage in the struggle for exist'ence. The protection of this class of fishes may be better secured as 'M. Marion proposes, that is, by establishing closed districts for a series 'of years to serve as a refuge for persecuted species, and changing their 'position every three years.' Elsewhere he repeats :—'To establish close 'times for all the species appears to us not only inconvenient, but 'impossible to make it effective in practice. It only falls to impose them 'on certain sedentary species and in certain stated localities.' The very immature fish sold in the markets of Spain and France would find no purchasers with us at all.

Papers on the fishery in the time of the Phœnicians, with reference to numismatics, and the 'Protection of Galicia,' are in the January number, the latter calling attention to the absolute necessity for the removal of duties on materials required in the trade.

The papers of the Fishery Board for Scotland are freely referred to and translated; and, while Spain is doing little as yet in a practical way itself to elucidate fishery problems, a station has been established at Santander, and much interest is taken in the whole subject by this intelligent Spanish Commission.

## XII. ITALY.

I am indebted to Professor Giglioli for an official publication of great interest in connection with Italian fisheries specially, and with sea fisheries generally.* It contains reports of a number of discussions on important questions by the Fishery Commission. One of these concerned the limits of territorial fishing rights, about which doubts had arisen in the application of certain laws in connection with trawling. Opinions were obtained from various Port-Commissions (*Capitaneria di porto*), &c., which were varied in their nature, but had reference, in fixing a line, to the limits within which fishing with trawl-nets (*reti a strascico*) might be deemed injurious. The opinions on the extent of the territorial limit most suitable, from the fishery point of view, varied from 1 to about 10 kilometres; or, it was suggested, that the range of modern artillery should be taken as a guide. But a large number of the answers suggest the propriety of taking into consideration the depth of water and the nature of the bottom, as well as the distance from shore in fixing such limits. The Fishery Commission also obtained information from a number of Maritime States in Europe as to the territorial rights in the respective countries, and the regulations regarding trawl-fishing within those waters. It was resolved that the following addition should be made to the law (Art. 16 of 1882):—That there shall be understood by territorial waters, and in reference to fishing with trawl-nets (*reti a strascico*), from *piroscafi*, a zone of three maritime miles (5553 metres), measured from low water, *in calma*, and in creeks and bays from a line formed by the points of entrance, and where the entrance is greater than ten maritime miles, from the point where this width begins. But the district and sub-district Commissions, taking into account the depth of the water and the nature of the bottom, may propose a distance from the land greater or less than three miles, in which for any district or sub-district it may be convenient to allow *piroscafi* to fish with drag-nets; but this proposal the Minister of Agriculture, Industry, and Commerce will order in concert with the Minister of Marine.

From a previous publication of the Department,† it appears the coasts of Italy are divided into six districts, each of which comprises a number of sub-districts (*Compartimenti*), varying from two to five, there being in all twenty-three sub-districts. Each of these has apparently its own Commission. The total produce of the sea fisheries was (in 1886) 243,384 quintals, valued at 17,264,075 lire; the number of boats was 17,498, of a total tonnage of 50,510; and the fishermen numbered 50,734, of whom only 6508 were employed on the High Sea.

* *Annali di Agricoltura*, 1891. *Atti della Commissione Consultiva per la Pesca, Sessione luglio*, 1891. Roma, 1892.

† *Annali di Agricoltura. Notizie sulla Pesca Marittima in Italia.* Roma, 1887.

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